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LIAISON ACTIVITIES AT RESEARCH  
AND DEVELOPMENT INTERFACES: A MODEL,  
SOME EMPIRICAL RESULTS, AND DESIGN  
CONSIDERATIONS FOR FURTHER STUDY

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## ABSTRACT

The thesis presents a basic interface model that identifies major sets of variables which influence liaison activities at research and development interfaces. Some research questions and propositions are extracted from the model. Further richness can be added to the model as literature from related substantive areas is more thoroughly surveyed. The model is intended to be a foundation to which further research can contribute.

Analyses of two empirical studies on liaison relationships are described. Although the settings vary, one proposition was common to both studies. It was found that there was marginally significant support for the proposition that liaison agents who were perceived as group members are also perceived as effective. An inverse relationship between distance and certain aspects of interface communication was supported. It was not possible to draw any firm conclusions about the behavior of liaison agents during project crises because of insufficient data.

A discussion of methodological problems is included. Certain aspects of research design for field experimentation on interface activity are elaborated, and a potential experimental design for the study of liaison agent effectiveness is presented. Some possible data collection procedures and important elements of analysis of the potential design are included.

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## CHAPTER I - INTRODUCTION

This thesis is an attempt to present and discuss three different, but related aspects of the phenomena of liaison activities at the interfaces of the research function of an organization. As such, it represents both a summation of work already completed, and a basis for further explorations into liaison activities. The thesis is a part of the Northwestern University Program of Research on the Management of Research and Development directed by Dr. Albert H. Rubenstein. The program is described more fully in Rubenstein (1966(a) and 1966(e)).

Chapter II presents a basic model for the understanding of liaison and interface activity. Because of the lack of previous extensive conceptual work in this area, portions of the model are unsupported on bases other than intuition and common sense. To assure that the model is a reasonable formulation, papers written by several directors of research laboratories over a period of years have been surveyed for important concepts and recurring comments (Rubenstein, 1964-1967).

Although there appears to be little theoretical work on the specific topic of liaison (aside from considerable "wisdom" literature), several fields seem to be related to the more general phenomena of communication processes. Some of the small group work and role theory are quite relevant to the problem of how a liaison agent might emerge in a particular situation. Discussions of relations between groups may be found in much of the sociological literature. Especially pertinent are theories of conflict and cooperation. Writers concerned with semantic and speech problems can contribute to a better understanding of the process of translation which a liaison agent may perform at the boundaries of interfacing groups. Theories of information overload and of communication processes within organizations are also quite pertinent to the subject area. Further development of the present model must include a more thorough search of these and other areas in order to tie the model in with existing theory. The model presented here is merely a basic framework into which future conceptions may be integrated.

Chapter III discusses two empirical studies undertaken in widely different settings. Project HINDSIGHT is a large-scale study in several government and industrial locations.<sup>1</sup> In this paper, data from two large government laboratories are analyzed. The important variables involved are the existence of a liaison agent, perceived effectiveness of a liaison agent, perceived work group membership, project urgency, and several aspects of the communication processes including freedom to communicate, frequency of communication, and the amount of communication between groups.

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<sup>1</sup>Project HINDSIGHT is an activity of the Office of the Director of Defense Research and Engineering. During Phase I of HINDSIGHT, as an in-house program of research by the Department of Defense, information on key "research and exploratory development events" in the life of a number of selected weapons systems was collected to provide a base from which to identify and establish management factors for research and technology programs, and to measure the overall cost-effectiveness of the current generation of systems as compared with their predecessors. The Phase II activity, of which the study reported here is a part, is directed to the identification of management and other environmental factors related to research group performance. See Sherwin and Isenson, 1966; Rubenstein, 1966(c); Office of the Director of Defense Research and Engineering, 1964.

The primary problem involved in the HINDSIGHT study was that the data were collected in retrospect and were thus subject to unknown biases and distortions. This problem was largely avoided in the second study described. The second study was a small-scale pilot effort undertaken in three Chicago-area industrial firms to investigate communication patterns and relationships between marketing and research departments. The existence, effectiveness, and work group membership of liaison agents were the primary variables in this study. This study was useful in suggesting methodological and analytical refinements, but suffered mainly from a small sample size.

Chapter IV notes some of the methodological problems encountered in the studies described in the previous chapter. These problems are briefly discussed. General problems of research design as they are pertinent to the study of liaison activities are discussed at some length. Potentially useable research designs are evaluated and their advantages and disadvantages are noted.

The final section of Chapter IV presents an outline for a possible real-time experiment designed to determine whether a liaison agent has an effect on the performance of interfacing groups. The emphasis is on the design of the experiment rather than on other aspects, although data collection techniques and some potential problems of conducting the experiment are noted. It is felt that experiments of the type discussed in Chapter IV hold promise for generating significant additions to the knowledge of many organizational phenomena, of which liaison activities are one category.

## CHAPTER II - A MODEL

The model presented here is not intended to be a definitive or exhaustive representation of interface activities, or of the process of liaison. Rather it is an attempt to systematically put forth the variables (or groups of variables) felt to be important in the study of liaison, especially in a research and development setting. The intent is to show the major interrelationships between variables. The model is useful also as an aid in generating research questions for further study. Although some propositions are extracted from the framework of the model, a more detailed and thorough analysis would be expected to reveal more specific propositions suitable for testing in particular empirical studies.

### II.1 - Basic Definitions

The basis for the study of liaison processes is the necessity for transfer of information and for coordination between organizational entities of one form or another. These entities may be informal work groups, project teams, functional divisions within the research department, or other units. To be able to speak of a transfer between entities, one must somehow be able to distinguish the entities from one another and from other entities. In other words, the entities must be bounded and the boundary must be observable or measurable somehow in the real world. Since boundaries are of such basic importance to the study of interface activities, a rather extended discussion is included here on the concept of organizational boundaries.

#### II.1.1 - Boundaries

The delineation of boundaries of groups and organizations is, as noted by Campbell (1958) and Miller (1965), usually an imperfect and approximate procedure. Higher level systems, such as the organization, typically have "fuzzier" boundaries than lower level systems such as rocks, cells, or organisms. In order to assure oneself that these higher level aggregates are indeed bounded entities, Campbell suggests that one make explicit the virtually automatic processes used to assess boundaries in lower level systems. Campbell's solution is a set of empirical operations designed to give clues as to whether a particular collection of individuals acts as a bounded entity.

Before discussing operational problems however, it is appropriate to state more explicitly what is entailed by the term "organizational boundary." A survey of several writers, including organization theorists, sociologists, political scientists, psychologists, and systems theorists, resulted in Tables 2.1-2.3. Tables 2.1 and 2.2 show in summation form the main elements of structure and process of the boundary subsystem as mentioned by the various authors. Table 2.3 identifies primary variables and characteristics of the boundary.

The conclusion to be drawn from these tables is that while there is no general agreement on exactly what an organizational boundary is, there is some agreement on certain elements of the boundary. For example, most authors feel that the boundary is a barrier of some type and performs the function of being a selective filter and maintaining autonomy. Virtually all the authors feel permeability is an important characteristic of boundaries, and half of them mention boundary roles as important phenomena. Although this survey was conducted with respect to the behavior of an organization in its environment, most of the properties and

Author →	Miller (65)	Katz, Kahn (66)	Kaufman (61)	Guetzkow (66)	Thompson (67)	Coplow (64)	March, Simon (68)	Campbell (68)
Elements of Structure								
Region	X	X						X
Set of criteria			X				X	
Set of expectations					X			
Limits of: communication channels	X			(X)				X
technology					X	X		
membership (participants)					X		(X)	
program and services					X	X		
Barriers		X	X	X		(X)	(X)	X
Physical		X	X	X		X		X
Psychological		X	X					X
Facilitative elements		X	(X)	X		(X)		

Items in parentheses were not directly mentioned by the author, but were inferred from their discussions of boundaries.

TABLE 2.1  
Common Elements of Boundary Structure

Author →	Miller	Katz, Kahn	Kaufman	Guetzkow	Thompson	Coplow	March, Simon	Campbell
Elements of Process								
Unification	X		X			X		X
Continuity			X					X
Selective filter	X	X	X	X		(X)	X	
Autonomy-Protection	X	X		X				X
Reduce uncertainty			X	X	X			
Maintain independence of action						X		
Differentiation			X	X		X	X	
Interdependence				X			X	X
Maintain environmental support		X						

Items in parentheses were not directly mentioned by the author, but were inferred from their discussions of boundaries.

TABLE 2.2  
Common Elements of Boundary Process



Author →	Miller	Katz, Kahn	Kaufman	Gvetzka	Thompson	Caplow	March, Simon	Campbell
Boundary Variables and Characteristics								
Continuity in space(proximity)	X				X			X
Continuity in time(common fate)	X		X	X				X
Permeability	X	X		X	X	X	X	X
Kinds of inputs	X							
Percentage of all inputs which are accepted(resistance to intrusion)	X							X
Changes at the boundary in transmission rates, costs, frequency or lag	X	X						X
Visibility of the boundary		X	X					X
Elasticity vs. rigidity of the boundary				X				
Roles at the boundary		X		X	X		X	

TABLE 2.3  
Common Boundary Variables and Characteristics

characteristics uncovered seem to be typical of boundaries of a large number of organizational entities including divisions, departments, and groups within an organization.

As might be expected, the definitions of boundaries were found to vary in ways consistent with the interests of the particular author. Katz and Kahn(1966) for example, being interested in the organization as an open system, stressed the facilitative as well as the barrier devices found in the boundary subsystem. Caplow, on the other hand, was more interested in the internal workings of the organization and found boundaries to be significant only to the extent they affected various internal variables of interest. Similarly, the definition of boundary used in the subsequent model is not intended to be broadly general, but is arbitrarily chosen for the particular purpose at hand. The definition itself is not arbitrary however, and is composed of several of the elements outlined in Tables 2.1-2.3.

The definition which follows is in the context of an R and D laboratory and is applicable to the department or lower level. First it is assumed that the boundary is not well-defined or formalized and exists primarily as a set of common expectations among current members of the group or department. The boundary is assumed to consist of certain physical and psychological barriers to potential inputs in the form of members and information. A suitable definition would be "a common set of expectations (held by members of the entity) about physical and psychological barriers to inputs in the form of persons and information." The basic

characteristic is the selective permeability of the boundary to persons and information. This definition includes such phenomena as what a new recruit to a laboratory must do to "prove himself," what groups of the laboratory are considered responsible for certain technical competencies, and what physical areas of the laboratory "belong" to certain groups.

To determine the boundaries of a given entity, the above definition implies that one must identify certain persons and certain communication channels. Since the boundary is defined in terms of common expectations, one way to locate the boundary would be to ask people who are in the group. This is a common procedure and has the disadvantage that very rarely does everyone agree on who are in fact the members of the group. This may occur because some persons may be group members with respect to certain criteria and at certain times, but not at other times. To locate communication channels, variations of this technique may ask persons to respond to situational-type questions of the style, "Whom would you talk to if such-and-such happened?"

In addition to direct questioning, observation may often be quite helpful in ascertaining both physical and psychological barriers. Offhand remarks such as "What's he doing here?" or "Why were you talking to him?" when coupled with other information, may often provide grounds for strong inferences about boundaries. At any rate, it would seem valuable to use several techniques to ascertain the boundaries of a given entity. Campbell discusses several kinds of procedures for doing this. A brief review of these may be helpful in suggesting potential operational techniques. If at least one technique utilizing each of the indices he suggests could be used, one would have a strong estimate of the boundary location.

Campbell (1958) advocates the use of various techniques to ascertain the existence of a quantitative difference between phenomena within the entity and between the entity and its environment. A primary index which he suggests is a "coefficient of common fate." This index is a measure of the degree to which "elements...move together in the same direction, and otherwise in successive temporal observations." Common fate is essentially a measure of the continuity in time of a group or organization. Continuity in space is not a requirement of common fate although the two often occur together. In organizations however, various elements may be quite separated in space and still have a common fate. The index is therefore relevant to higher level system boundaries.

A second indicator that a bounded entity exists is the degree of similarity of the elements. The assumption is that similarity is greater among members within the entity than between members and nonmembers. It would be necessary to get readings of similarity on several dimensions (e.g., work patterns, activity levels, profile similarities, identifying marks or uniforms) to be able to use this indicator. Generally, this indicator does not seem to be as powerful as the index of common fate.

Spatial contiguity or continuity in space is the third clue to the "entitativity" of a given system. Campbell discusses these properties under the term proximity. In general, proximity seems to be closely interrelated with the other indicators, but it is not alone a necessary or sufficient factor. Campbell says"

For human groups, face-to-face communication processes made

possible by proximity generate similarity and feelings of belongingness which make coordinated action and hence common fate more likely (p. 22).

In groups and organizations, communication channels and information flows are basic connecting links which help hold the system together. Measures of differences in the frequency, rate, costs and lag in transmission are possible clues to boundaries. Campbell, Deutsch (1954) and others (Table 1.3) suggest the use of diffusion limits or diffusion rate discontinuities (or their equivalent) as indices of boundaries. Like the other indices, the difference between intra-entity and inter-entity flows is the crucial factor.

The absolute value of indices of common fate, similarity, proximity, and diffusion is relatively unimportant. The basic indication that a bounded entity exists is the occurrence of a difference between the intra-entity and the inter-entity value of each index. The primary characteristic of a boundary is that it distinguishes a given collectivity from the environment at large. Therefore, a difference is to be expected on these dimensions as suggested by Campbell. The degree of difference is some indication of how well-defined the entity is. One would also expect the estimations of the boundary resulting from the various indices to converge if a true boundary exists. Thus the degree of convergence of the estimates is a further indication of the "reality" of the boundary.

Reflection or resistance to the intrusion of external energy is a further property which may be helpful in the location and delineation of boundaries. The selective impermeability of boundaries is a primary phenomenon of higher level systems and may often be effectively used to infer the boundaries themselves. System procedures for receiving and/or expelling members, information or other matter-energy may give clues both to the rigidity of the boundaries and to who and what is included within the boundaries.

#### II.1.2 - Interface

An organizational interface is defined as a common boundary between two or more organizational entities. A common boundary implies that the expectations of two groups must be tangent or overlapping. It would seem that overlapping boundaries would be potentially more conflict-producing than tangent boundaries.

Since boundaries include both physical and psychological characteristics, two entities may have interfaces on any of a number of dimensions. For example, they may have common physical boundaries, use the same communication channels for certain purposes, have one or more members in common, or require the same information. All of these dimensions are important when discussing the activities of a liaison person..

It becomes apparent that interfaces can be classified on the basis of what types of boundaries the entities have in common. Other bases of classification are also possible. Douds and Rubenstein (1966) described interfaces on the basis of whether they were coordinative or transitional, indicating whether the relationship between groups was in parallel or in a serial sequence. Interfaces may also be classified on the basis of the kinds of units involved (e.g., groups, departments, organizations). The number and types of communication channels between entities may also provide a convenient base for categorization. It

seems likely that significant differences exist between groups which have generalized interpersonal contact vis a vis those which communicate through one intermediary. At various times, all of these descriptive categories will be used to aid in the discussion of interfaces.

#### II.1.3 - Transactions at the Interface

In systems theory terms (Miller, 1965; Katz and Kahn, 1966), two basic types of transactions may occur at the boundaries of an entity: Either matter-energy or information of one sort or another must be transferred. The transfer of information appears to be the more significant in the study of research and development and most of our attention will be confined to interfaces involving information transfer.

A primary reason one is interested in interfaces in organizations is because of the humans involved at these boundaries. Interface problems which do not involve humans can be reasonably well handled by the present state of technical knowledge. For example, it is possible to design industrial plants with many interfaces, but which are completely automated and which have little variance in the planned processes and rates of input-output at the interfaces. These types of interfaces require primarily technical-engineering knowledge and are not discussed extensively here.

In sum, this model is concerned with R and D interfaces at which an information transfer involving humans occurs.

(It should be noted that all information must be transmitted on "markers" of some kind and that these markers are some form of matter-energy. Therefore, in order to transfer information there must be some matter-energy transfer as well. In the succeeding discussion, Miller's distinction between information and matter-energy transmissions will be adopted (1965, p.199): If the receiver responds to the information aspects, the transfer will be considered to be an information transfer.)

#### II.1.4 - Liaison Role and Agent

As shown in Table 2.3, the existence of roles at the boundary to perform certain specialized functions is recognized by several authors. The liaison role is one of these boundary roles which may be developed by the organization to aid in the transfer of information across boundaries. The role may be formal or informal and it may be developed consciously or it may evolve in an "evolutionary" manner as the organization responds to the need for better information transfer. In either case, the following definition holds: A liaison role is a set of activities whose intended function is to insure coordinated and/or cooperative action between organizational units by means of effective communication. A liaison agent is any person who acts in a liaison role.

In attempting to insure coordination and cooperation, there appear to be three functions which the liaison agent performs. One function is to aid in the translation of information from the language of one of the interfacing parties to the language of the other. In a research setting, this function is especially important when one of the parties is not technically oriented.

Sanders (1963, p. 80) for example, claims:

Being accustomed to communicating easily and deeply with colleagues in his own or closely related fields, the average scientist or engineer is subject to particular frustrations in trying to communicate with persons in non-technical or distantly related fields. On the other hand non-technical people are usually confused by the scientist's special terminology, technical dialects, and abbreviated references to laws and principles.

A second function which liaison agents perform is integration of the activities of interfacing entities. This would be a common function of the liaison agent in research laboratories where groups must make certain that various components and specifications are feasible with respect to other parts of the overall project.

Liaison agents are also hypothesized to perform a function which might be called boundary definition. Especially when responsibility for a project is being transferred from one party to another, the liaison agent is important in assuring that all parties understand when the responsibility changes hands and what each party is responsible for up to that time and subsequent to that time. The essence of boundary definition is not the actual placement of the boundary, but the set of expectations held by the interfacing entities. When the expectations are "congruent" (that is, when each party's responsibilities are clearly understood by each other party), a smooth interface transition would be expected. When expectations are not congruent, problems in transition are likely to occur.

## II.2 - Components of the Model

This section of the chapter discusses the components of the model as shown in Fig. 2.1. The characteristics of the components are discussed and some of the interactions of the components are investigated.

### II.2.1 - Organizational Structure

The structure of the research and development department is a basic determinant of the location and kinds of interfaces found within the laboratory. The overall organizational structure has important implications for inter-departmental interfaces. In both cases, the organizational structure provides the framework within which the various organizational units must act. The structure plays an important part in determining which groups will be interacting and the reasons for which they will be interacting.

Three types of boundaries are usually defined by the organization. First, the organization usually divides various sets of activities into different units on the basis of function. Within the laboratory, functional separation is also common. Secondly, administrative boundaries are typically quite explicitly stated. The organization chart clearly outlines the important administrative boundaries within the organization and each department. Physical boundaries are also affected by organizational structure although they may often be less formally defined than functional or administrative boundaries. Included within the concept of physical boundaries is the question of who is

responsible for certain equipment as well as the problem of geographical location within the physical limits of the organization.

The organizational structure is a composite result of many factors. The model does not attempt to represent all of them but lumps them into three large categories. One of these is the set of organizational objectives. The structure of the research laboratory may vary considerably depending on whether among the dominant objectives are to develop an outstanding scientific staff, to serve a maintenance function, or to contribute to the long-range profitability of the organization. A second category is the effect of the environment. These effects are probably felt primarily through modifications of organizational objectives, but some may influence structure directly. For example, knowledge of how a competitor designs his research department may influence the structure of one's own laboratory. The third category includes the continuous feedback which occurs as a result of the actual operating of the organization. This may often result in a type of heuristic or trial and error modification of the structure.

Creation of boundaries through structural separation usually leads to patterns of differential interactions and activities. These patterns tend to reinforce the existence of boundaries through the emergence of common sets of expectations and the formation of informal work groups. That is, collections of persons within the same physical area tend to have more interaction among themselves, regardless of their similarity in terms of function and administrative boundaries. However, in the normal situation, the functional, administrative and physical boundaries often are closely related if not identical. This situation tends to increase the visibility and rigidity of the boundary, further solidifying the group.

In addition to being a function of organizational structure, work groups are also affected by common interests and contacts outside of the organization. In the research laboratory, this additional potential source of interaction may often be important in affecting work groups. Outside contacts may tend to strengthen or weaken existing work groups depending on whether such contacts are within groups or across groups.

The functional, administrative and physical boundaries within the research laboratory may often not coincide with the required flow of work. Thus research projects usually involve a considerable amount of communication and contact across all of these boundaries. Because the interface problems are often especially severe within functionally oriented laboratories, project teams utilizing persons from several functions have become a popular solution. These teams attempt to minimize functional, administrative and physical boundaries and to substitute instead boundaries on the basis of the project. The intent is to increase the effectiveness of the laboratory by decreasing the necessity for extensive coordinative interface contacts. The need for coordinative interfaces still exists, but they are shifted to interfaces between project teams rather than between functional groups. Hopefully such interfaces are easier to handle than functional interfaces. (See Lazar and Kellner, 1964, Kirkjian, 1963 and other writers in the IEEE Transactions on Engineering Management for further comparison of the project-type and functional-type structure.)

The important point of this discussion is that the structure of the labora-

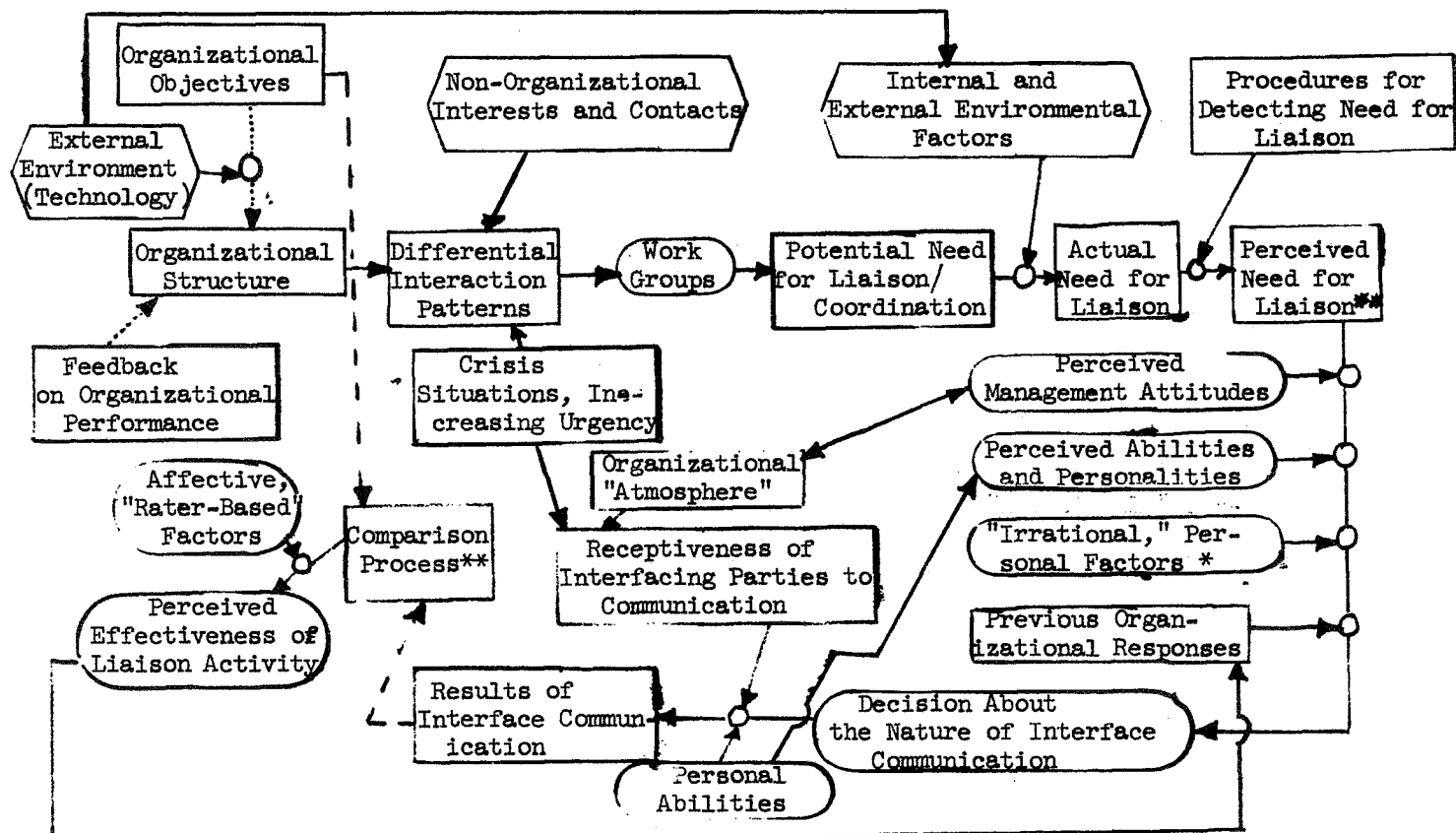


Fig. 2.1, A BASIC INTERFACE MODEL

\* The term "irrational" refers to organizational purposes and rationality rather than to individual rationality

\*\*Done at both individual and organizational level.

— Solid line implies a relationship of one variable influencing another  
 ..... Dotted line implies a very weak relationship of one variable influencing another  
 ----- Dashed line implies a comparison process

Organizational  
Level

Individual  
Level

External  
Factors

tory and the organization create certain organizational entities which are then required to work together and cooperate in ways determined by the flow of work and technology of the organization. (The technology of the organization appears to be largely dependent on the particular environment of the organization.) Thus, given the technology and flow of work of the organization, the structure creates entities which require varying degrees and kinds of interface activity to accomplish the desired results. Chapple and Sayles (1961) discuss the interaction of organizational structure and the flow of work quite extensively. They stress the point that the structure and the flow of work must coincide or else problems of coordination and communication are likely to arise.

#### II.2.2 - The Need for Coordination and Liaison

The model develops the notion that organizational structure, by imposing various sets of boundaries, tends to create formal and informal interfacing entities (II.2.1). Because the demands of the flow of work often call for coordinated activity across the boundaries of these entities, the potential need for liaison is transformed to an actual need. The particular event which triggers the need for coordination may arise within the organization from some other department, within the research department, or from some external source such as a customer.

Whatever the source, some event triggers the need for coordination between units, but obviously, the existence of an actual need must be perceived by the organization in order for a response to occur. Often there are specialized subsystems at the organizational level which are sensitive to needs arising in the environment (e.g., sales offices, customer complaints departments, market research section). At the laboratory or group level, the need is usually perceived in one of two ways. One procedure widely advocated is to anticipate the need through systematic planning. This is usually done formally at some management level. It is probably informally done by many persons at all levels who have had some experience with the particular phenomenon. (One reason that experienced personnel are valuable is that they can foresee the necessary interactions with other groups required by a particular project.)

The second way that the need for liaison is often recognized is through feedback of one sort or another which indicates that something is incorrect or not proceeding well. Rather than foresight, this method involves hindsight or reaction to an existing situation. One would presumably prefer the planning method to the feedback method because the latter would tend to allow inefficient or dysfunctional practices to continue until such time as they become severe enough to be brought to someone's attention. It is conceivable that considerable damage may have been done by that time.

#### II.2.3 - Interface Transactions

Once the need for some sort of liaison activity has been recognized, some type of actual liaison activity may take place. The particular nature and kind of communication will be a function of several different intervening factors. One important factor is the past history of responses to similar situations, or the existence of routinized procedures for the handling of certain occurrences. (J.D. Thompson, in a seminar at Northwestern University, 1967, and Herbert Kaufman, 1961, both have mentioned the importance of knowledge of past history of an organization in being able to understand an organization's current res-



ponse to stimuli.) Past history may be especially important in the selection of an appropriate communication channel to handle various types of interface problems.

Related to the factor of the past history of organizational response is the set of factors concerned with perceived personalities and abilities. Experience with individuals and knowledge of their particular capabilities would appear to be an important determinant of the nature of liaison processes of both a formal and informal type.

Another set of factors is related to the organizational "atmosphere." In the model, this set has been indicated as perceived management attitudes. Especially when the liaison process is informal, it would seem that perceptions as to what management attitudes are in regard to the use of informal means to achieve cooperation would influence the nature of the liaison efforts. For example, when management is perceived as discouraging horizontal communication, there may be a tendency to refer problems of communication to the hierarchical chain of command rather than attempting to solve them through direct liaison efforts.

Aside from the so-called "rational" factors mentioned above, certain "irrational" factors (from the point of view of the organization) may have an effect on the liaison process. Dorsey (1957) points out that control of information and information channels is a potential source of power in the organization. It seems possible that personal attempts to increase one's power or status within the organization may often take the form of handling the communication processes between entities. Making oneself "indispensable" to the effective functioning of the laboratory is one type of irrational factor that may influence the nature of the liaison arrangements. (From the individual viewpoint this is certainly a rational act, but from the organizational viewpoint assumed here, such acts are described as "irrational.")

#### II.2.4 - Comparison Process

Once interface communication has occurred, there is some evaluation of the effectiveness of that communication in terms of the objectives of the laboratory, project team, or group (depending on the circumstance of the particular incident). The comparison results in a judgment of the perceived effectiveness of the communication and of the communicator, which may in turn affect future interface contacts.

The comparison procedure leading to perceptions of effectiveness may occur on varying degrees of formality, but it is implicit in all information transfer across boundaries, especially when one or a few persons are designated to represent other persons. When a formal liaison exists, the evaluation procedure may often itself be formal and involve ratings and judgments of superiors in the organization. When the liaison is on an informal basis, judgments of effectiveness may often be informal and exist primarily as opinions among the peer group of the person acting as liaison. In some cases, it may be that judgments of effectiveness are not on a conscious basis. Instead, selective reinforcement of a particular communication channel may lead to further use of that same communication channel without any conscious recognition of the effectiveness of the channel. In both the formal and the informal case however, expectations based on past experiences and effectiveness are likely to influence future liaison activities.

As indicated in the model, perceived effectiveness is a function of several factors which may be grouped into two categories on the basis of whether they are related to the actual effectiveness of the liaison agent or to the personal biases of the rater. In some cases of course, knowledge of the biases of the rater may influence the actual effectiveness of the liaison agent by causing him to change his normal behavior in some way.

#### II.2.4.1 - Actual Effectiveness

The objective measurement of the actual effectiveness of a particular liaison arrangement is difficult because it involves measurement of the effectiveness of information flow. A given act of information transfer may be evaluated on at least three levels - the symbolic level, the semantic level, and the pragmatic level (Shannon and Weaver, 1949). Effective communication at the symbolic level implies that the information markers have been accurately transmitted from source to receiver. Within an organizational context, effective symbolic communication may mean that information has been successfully transmitted in a physical sense to the desired persons.

Effective semantic communication occurs when the information is "understood" by the receiver in the same sense as it was sent by the source. This implies that in addition to physically receiving the information (e.g., by letter, pamphlet, phone call), the same pattern of imagery exists in the mind of the receiver as in the source when the message was sent (Cartier and Harwood, 1953).

At the pragmatic level, the effectiveness of communication is judged by the degree to which the result intended by the source is achieved as a result of the communication (Rubenstein, 1957). The effectiveness of most communicative acts in an organization would seem to be judged at the level of pragmatic effectiveness.

It is important to remember in this discussion that reference is not made to three different "levels of communication," but rather to three different levels of analysis of the effectiveness of communication. Any single act of information transfer may be evaluated at all three levels provided the evaluator knows the "real" meaning at both the source and receiver, the actual and intended results of the communicative act, and the symbols as they were sent and received. This is, of course, impossible to do in the case of human communication because of the mediating effects between the sending or reception of the symbols, understanding of the symbols, and the purpose that led to, or acts that derived from the communicative act. These mediating variables are shown in Fig. 2.2 which is a slight modification of the common diagram used to illustrate communication processes (Rubenstein and Haberstroh, 1966, p.381). The figure shows that the three levels of analysis apply to only one act of communication, and also indicates why it is difficult for an outside observer to judge the effectiveness at any level because of the possibility for many unknown mediating effects to occur.

Because it is difficult to evaluate directly the effectiveness of information flows, it is usually necessary to use various phenomena which are felt to be valid indicators of effectiveness. Indicators are available to assess all levels of effectiveness, but since organizations typically stress pragmatic

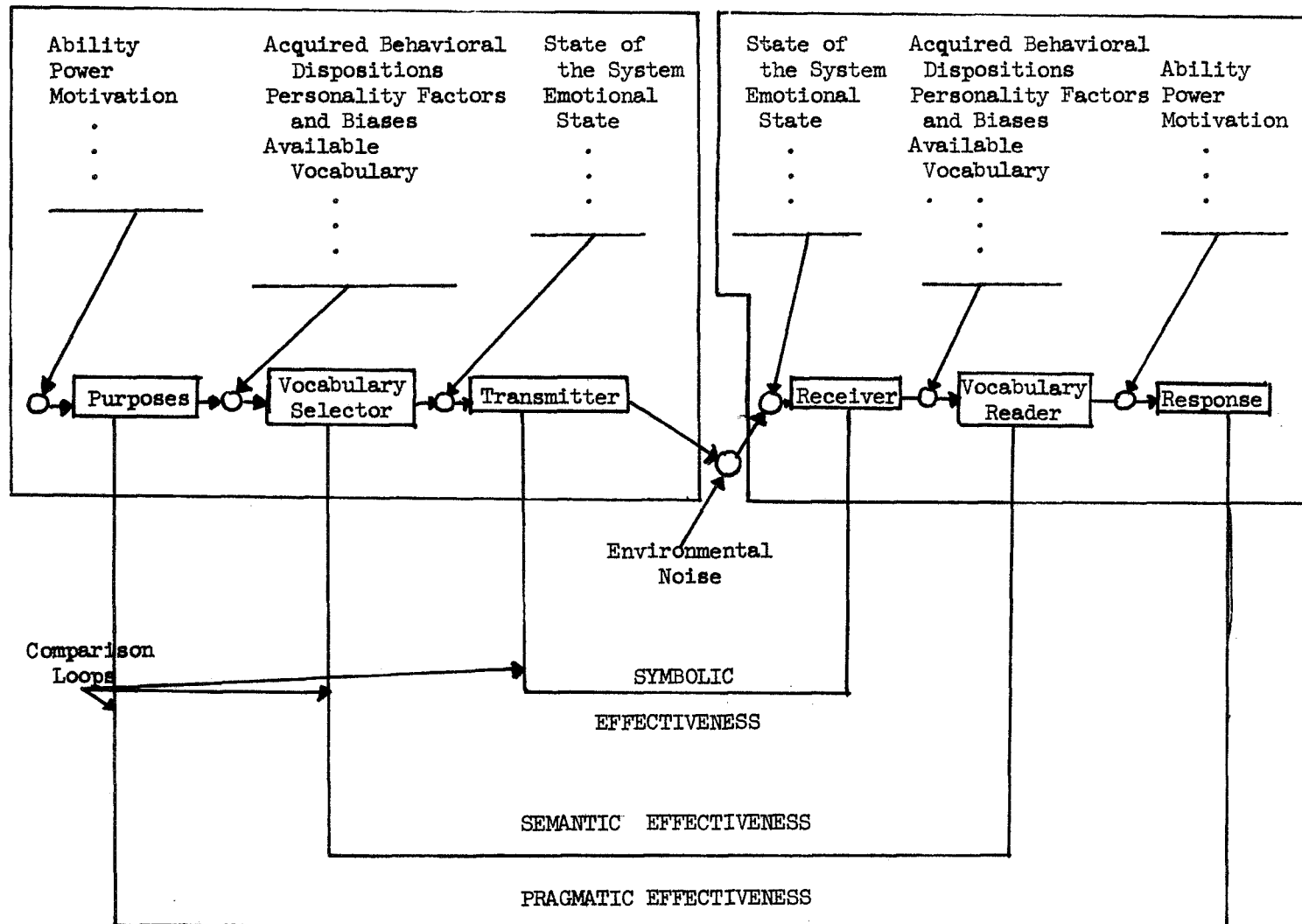


Fig. 2.2, A Communicative Act

effectiveness, these indicators are probably most common. In a research laboratory, indicators of the pragmatic effectiveness of communication between groups might be expressed in terms of the percentage of projects being completed on time, project costs remaining within budgets, good coordination and cooperation between groups, amount of complaints from both employees and outsiders, critical incidents between groups, and other general measures of the "productivity" of the laboratory or groups within the laboratory. At the group level, group members would probably consider a liaison person to be effective to the extent that he adequately protected and represented the interests of the group.

Several factors are seen as influencing the accomplishments of the types of criteria mentioned above. The actual accomplishments of any liaison agent will depend to some degree on his particular abilities and characteristics. His personality and ability to handle potentially stressful or conflictual situations are important factors affecting the degree to which he will be effective in promoting cooperation. Kahn, et.al. (1964) have done an extensive study on persons in situations of organizational stress and have identified personality factors as a major variable.

A second set of variables may be subsumed under the heading of organizational factors. This includes the effects of the "organizational atmosphere" previously discussed as well as factors peculiar to the situation. Certain groups may be more receptive to coordinative efforts through liaison agents because of past history or because of unique reasons such as close relations between members of interfacing parties. Also important is the urgency of coordinative efforts as perceived by the interfacing entities.

#### II.2.4.2 - Affective, Rater-centered Factors

In addition to the objective reality of the situation, the personal "irrational" biases of the rater enter into the determination of perceived effectiveness. When the rater must judge effectiveness as a formal function, there are often efforts to minimize his bias to make his judgment as objective as possible. Normally these methods take the form of management techniques of some sort.

Often however, the perception of effectiveness is on an informal basis (and perhaps not consciously recognized as a judgment of effectiveness) and the effects of personal biases are incorporated into the judgment. In cases where a person emerges as an informal spokesman and liaison agent for the group, the effects of personal biases may sometimes carry as great or greater weight than the actual accomplishments of the liaison agent. The in-group (the group which the agent represents) may perceive him as quite effective because he is recognized as striving for the "good of the group," while the out-group may perceive him as a threat and judge him to be ineffective.

#### II.3 - Questions Suggested by the Model

The development of the model up to this point has made no specific assumptions about the setting of the liaison activities within the organization although illustrations involving the research department have been used. The questions and propositions which follow assume as a setting a large research laboratory of which many government laboratories would be typical. This assumption is mainly for the purpose of simplifying the discussion rather than because the questions and propositions are thought to be restricted to that locale.

Although the model presented here and the questions and propositions which follow are attempts to explain or describe certain organizational phenomena, interest is also expressed in the ways in which the model may be useful in the design of organizations. It seems that the ultimate value of studies such as this is the application of whatever knowledge may be gained. Therefore, in several instances the relevance of propositions and research questions to research practitioners is discussed.

A basic proposition upon which the logic for several of the succeeding propositions relies concerns the differences between the nature of formal and informal liaison relationships. Formal liaison relationships are those in which a person or persons have been officially designated by some higher authority to act as liaison between two or more organizational entities. Informal liaison refers to any instance in which a person or persons are acting as liaison without official designation. Informal liaison may or may not be officially recognized by higher authority, but when it is used by such authority, informal arrangements tend to reach the status of formal liaison.

Informal liaison persons tend to emerge out of situations and groups when the need for coordination arises and no mechanism exists to fulfill this need. It would seem that small group research and especially research on the concept of group leadership is relevant to exactly how and what the process of emergence is and how it takes place.

The basic proposition describing the difference between formal and informal liaison relationships is:

Proposition I: To be perceived as effective by group members, informal liaison agents must be perceived as protecting the interests of and representing the referent group. It is not necessary for formal liaison agents to be perceived as representing group interests for that group to perceive such agents as effective.

Underlying this proposition is the assumption that the peers of informal liaison agents (the referent group) will allow the liaison agent to maintain his position of potential power as spokesman for the group only as long as the agent is perceived as providing some benefits for the group. When the liaison agent is responsible to a higher authority, the referent group is more likely to recognize this responsibility and realize that the agent must satisfy certain organizational demands which may conflict with group demands. Thus formal liaison agents will tend to be evaluated (by group members) more according to their accomplishments in relation to organizational objectives than in relation to group objectives. In sum, the liaison agent is seen as owing allegiance to the "authorizing" source, with the term authorization used as suggested by Scott, et.al. (1966). In Scott's formulation, a person is authorized to the extent that significant evaluators permit him to attempt to control and require the compliance of others with the control. The significant evaluators for the informal liaison agents are his peers while significant evaluators are usually management personnel for formal liaison agents.

### II.3.1 - Research Question A

One major question suggested by the model concerns the relationship of the structure of the organization to the needs for different kinds of liaison activity.

Question A: How and in what ways do different kinds of organizational structures affect liaison activities?

Within research laboratories the two prominent types of structures may be described as function-oriented or project-oriented. The following discussion will consider structure in terms of these two stereotypes although it is realized that few laboratories are probably either purely function-oriented or purely project-oriented.

The basic effect of different kinds of organizational structure is felt through the creation of different interfaces. The interaction between the flow of work required by the technology of the organization creates a need for liaison of some type between units within the laboratory. As projects become more complex, the need for continuing contributions from several disciplines requires considerable contact across administrative, physical and functional boundaries in the functional organization. The normal hierarchical communication channels are not usually designed to facilitate the horizontal communication across boundaries required by these complex projects. Also, opportunities to develop horizontal channels are often limited because of the restricted viewpoint enhanced by functional division. Hence one would expect that most work groups or referent groups would develop along functional lines. Applying Proposition I to this situation, successful liaison agents would find it necessary to protect the interests of groups essentially along functional lines. Given the situation of complex projects which require interfunctional relationships, the existence of informal liaison agents which attempt to further the interests of functional groups can lead to potentially dysfunctional situations.

In project-oriented laboratories, the referent group for informal liaison agents will tend to be the project team composed of representatives from several functional areas. By drawing members from several areas, the project approach incorporates within the team many of the interfaces which must be dealt with across boundaries in the functional organization. The common factor of members of the project team is the particular project they are working on rather than a particular function or discipline. Thus by Proposition I, in order to remain successful and be perceived as effective, an informal liaison agent must protect the interests of the group, which are in this case similar to the interests of the organization. The proposition to be drawn from this reasoning is:

Proposition II: The existence of informal liaison agents is more likely to produce dysfunctional consequences in functionally-oriented laboratories than in project-oriented laboratories.

This proposition does not mean to imply that informal liaison agents are dysfunctional in functionally-oriented laboratories. What is implied is that other things being equal, in general there is a higher chance for informal liaison agents to have dysfunctional consequences in function-versus project-oriented laboratories. The point of the proposition is that given the need for interfunctional cooperation, the arrangement of the organizational structure alone is a factor in the effectiveness of informal liaison activities.

Other factors relevant to the particular situation would influence effectiveness in a given instance. However, many of these factors, such as the personality traits and acquired behavioral dispositions of members, are beyond

the control of the organizational designer or manager whereas the structure of the organization is one factor which can be reasonably easily manipulated. Should the proposition be tested and verified, it would behoove the designer or manager to examine and be aware of the groups which a particular structure leads to and to then notice the interplay between these groups and the relationships required by the flow of work.

Project-oriented organizations may have project groups with varying degrees of permanence. Sometimes the groups may be relatively permanent and other times a group may exist only long enough for a single project to be completed. The permanence of the group, both in the functional and the project-oriented organization would seem to influence the nature of the liaison communication patterns. Many writers (e.g., Dorsey, 1957; March and Simon, 1958; Miller, 1965; and Guetzkow, 1965) have noticed the general tendency for a communication channel to be used again for other messages if it has produced desirable results on previous occasions. If liaison arrangements exist between groups, one would expect them to be better defined in more permanent groups and less well-defined in groups of a temporary nature. (A well-defined liaison arrangement is one in which the communication channel is relatively narrow and there are few communicative contacts between groups which do not fall into this channel. It is thus something which must be determined empirically in a given situation.) Where liaison arrangements are well-defined between two groups, it seems likely that intergroup communication will be more effective than where liaison is not well-defined.

If interfacing groups are of a less permanent nature, one might expect considerable disruption of communication channels as groups are periodically rearranged. In this type of organization it would seem that the establishment of formal communication procedures would aid in minimizing communication disruption and increasing the effectiveness of communication. By establishing formal liaison procedures, perhaps as a liaison role, the communication channels can attain a certain amount of permanence outside the existence of the interfacing groups. As different groups are created for a project and moved into an interface relationship, the existence of a liaison role can help to minimize the lack of communication channels between the groups by providing established procedures for communication.

Proposition III: The permanence of the interfacing groups is directly related to the effectiveness of the informal liaison arrangements.

Proposition IIIa: The establishment of formal liaison roles will increase the effectiveness of communication transfer between interfacing groups which have a relatively short life span.

The logic behind these two propositions is based on how an informal liaison role is felt to be developed. It would seem that the emergence of an informal role would normally take a considerable amount of time before it was generally recognized and regularly used as a main communication channel between groups. Formal establishment of a role would bypass most of the development stages of the informal role and provide already established communication channels to be used for coordination purposes shortly after the synthesis of new groups. Formal liaison roles would thus be a useful device where groups are intact for only

short periods of time.

Although the organizational structure alone is hypothesized to have certain effects on liaison agents, it is to be expected that the particular flow of work required by the technology of the organization would interact with the structure to affect liaison activities. In particular, the flow of work will determine with what other units a specific organizational unit will have coordinative and transition interfaces. If the following proposition is true, then the flow of work will determine to some degree the nature of the activity which the liaison agent will perform in regard to different organizational units.

Proposition IV: At transition interfaces, liaison agents perform mainly a function of boundary definition; at coordinative interfaces, mainly an integration function. The translation function is performed at both types of interfaces with equal likelihood.

This proposition is supported to some extent by data taken from papers written by research personnel for a Seminar on Research and Development (Rubenstein, 1964-1967). A very common remark by many of these practitioners was the difficulty of getting a project transferred from one department to another in the organization. Many difficulties and misunderstandings apparently occur when a product makes the transition from research to development, from development to production, and at similar interfaces.

The translation function is mentioned most often in connection with interfaces involving marketing or finance personnel or with customers. The function of integration with other units is most frequently mentioned in regard to groups within the research department interacting with each other. Though these data are not by any means conclusive, they do seem to substantiate the common sense basis for the proposition.

It is interesting to note that these different functions require different qualities in the liaison agent. One may find that liaison agents which are effective as translators of information are not effective in performing integrative functions or in defining boundaries at transition interfaces. The qualities necessary for the translation function appear to be a knowledge of both languages being used. To aid in integration, the liaison agent would seem to perform well if he were able to look at and conceptualize the overall problem. Boundary definition appears to require a certain degree of bargaining prowess on the part of the liaison agent. Persons who have only one or a certain set of these qualities may not perform equally well in all interface situations.

### II.3.2 - Research Question B

A second area of the model from which testable propositions may be generated concerns the perceived management attitudes and controls.

Question B: How do perceived management attitudes and controls affect liaison activities?

Many practitioners write that the factor of organizational atmosphere is quite important in research and development laboratories. A typical quote is: "By the very nature of its task, a good research and development organization provides an atmosphere of excitement, unpredictability, and change" (Siepert,



1963). The problem posed by the question stated above is to identify some of the elements of the organizational atmosphere, and to investigate how these elements may affect liaison activities.

As the research question indicates, the organizational atmosphere consists of group perceptions about the attitudes management has toward various activities. Controls enforced by management are often taken as indicators of underlying management attitudes by employees of the organization. (i.e., Actions speak louder than words.)

Impressions as to management attitudes would seem to affect a great deal of the activity of research personnel. One might consider the effects of atmosphere on creativity, turnover, or several other items, but there appears to be one factor which is especially important in considering liaison activities: Management practices and attitudes which are perceived as affecting the degree of freedom to communicate are likely to influence the nature of intergroup communications.

Proposition V: Other things being equal, liaison agents are more likely to be found where the perceived freedom to communicate horizontally between groups and other organizational units is low (i.e., where there are perceived management barriers to communication) than where perceived freedom to communicate is high.

The logic behind this proposition is that liaison agents will not be used unless there is a need for them. Where the perceived freedom to communicate is high, there is normally no need for liaison agents unless there are other barriers besides management attitudes because the persons concerned with interface problems will communicate directly rather than through a liaison agent.

If liaison roles exist and the perceived freedom to communicate is high, it may be that the liaison agent would not be as effective (as discussed in II.2.4.1) as if the perceived freedom to communicate were low. This would occur because of multiple sources of information leading to more possibilities of confusing and contradictory information. It would seem that this would be the case for both formal and informal liaison agents.

Proposition Va: Given that a liaison role exists, liaison agent effectiveness tends to be higher with a low degree of freedom to communicate than with a high degree of freedom to communicate.

### II.3.3 - Research Question C

Another group of variables are concerned with liaison arrangements as they are affected by changes in the existing situation.

Question C: What are the effects of changes in organizational structure and project crisis on liaison arrangements?

Changes in the current situation which would effect liaison would often be in the form of perceptions of increased urgency, perceptions of impending

failure, or crises of other sorts on a particular research project. Another major source would be changes in management attitudes or control. The problem of defining what constitutes a crisis is significant and is not attempted in this thesis. However, it should be noted that the discussion here implies a definition of crisis in terms of participant perceptions rather than objective indicators of crisis. Also, Proposition VI is primarily concerned with the response to crisis rather than the means of perceiving or recognizing crisis. It is felt that the basic mechanism for explaining how liaison activities will be affected by various kinds of crisis is the defensive mechanism of boundary maintenance.

Proposition VI: During periods of crisis (from whatever source), the organizational unit which is threatened by the crisis will tend to be characterized by reduction of communication barriers within the unit and strengthening of barriers between the unit and other units.

This proposition implies a decrease in the freedom to communicate the threatened unit and other units. Applying Proposition V to this situation, it would be expected that communication through liaison agents would increase during times of crisis while communication through other channels decreased.

In empirically investigating this proposition, it is important to determine the organizational unit which is being threatened. If the entire research department is being threatened, one would expect higher frequency and rate of communication within the department, but more structured communication across the boundaries of the department through liaison agents.

#### II.4 - Summary Remarks

The model as it has been presented is merely a framework for the development of a theory of liaison activities. The propositions which have been extracted have been primarily concerned with the effectiveness of liaison agents because the empirical section of the thesis investigates this particular topic. The model can be extended in other directions as well and it is intended that further work will accomplish this. The model can be enriched by contributions from several areas of literature which will be more thoroughly surveyed as the model is developed more fully.

## CHAPTER III: TWO EMPIRICAL STUDIES

This chapter reports on two exploratory studies undertaken in widely different research sites. One of these is an analysis of interface data collected as part of Phase II of Project HINDSIGHT. Project HINDSIGHT is a large-scale study of government and industrial laboratories which attempts to identify, in retrospect, important factors relating to several areas of research and development management, including among other things, project selection, idea flow, and interface relations. Project HINDSIGHT data used in this thesis were collected by in-house personnel rather than by the writer. The second study was an investigation conducted in three industrial firms in the Chicago area. The purpose of this study was to pilot test certain instruments, to ascertain the relevance of several propositions about interface and liaison phenomena, and to gain practical experience in the techniques and problems of field research.

### III.1 - Project HINDSIGHT

#### III.1.1 - General Background and Sites

Phase II of Project HINDSIGHT (Sherwin and Isenson, 1966; Rubenstein, 1966(c)) was initiated for the purpose of attempting to identify significant factors associated with successful research and exploratory development (RXD) events.<sup>2</sup> The entire project included many areas of research on the research and development process of which the study of liaison and interface relations was one part. HINDSIGHT was conducted under the auspices of the Office of the Director of Defense Research and Engineering although training of the researchers, instrument design, and data analysis were undertaken by Northwestern University and the Massachusetts Institute of Technology.

Twelve sites were selected for study on the basis of a review of contributions to the development of certain weapon systems. (See Office of the Director of Defense Research and Engineering, 1964.) These sites, both within the government and in private industry, were identified as having made major contributions to these weapon systems in the form of significant RXD events. Particular groups within each site were selected on the basis of the smallest organizational element within which the specific RXD event may be said to have occurred. Individuals who were in the groups at the time of the events were then located and the appropriate instruments were administered to them. Needless to say, it was not possible to locate all of the persons who were group members of events which occurred from five to fifteen years ago. Where it was possible to identify group members, many persons could remember little about the event. This problem of retrospective data collection is discussed more fully in a subsequent section.

The data analyzed and reported here represent only two sites. These sites are the only two which have contributed a significant amount of interface data at this time (June, 1967). Both sites are well-known government sites. One is a naval laboratory and the other is an Air Force installation both are organized along traditional military laboratory lines. Condensed organization charts are included in Appendix A to indicate the general organization, the position of the

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<sup>2</sup>An event was defined in Project HINDSIGHT as an "activity (e.g., development, demonstration, investigation, study, etc.) which culminated in understanding of the phenomena, demonstration of principles, or specific embodiment of principles (e.g., technique, device, material, etc.)."

in-house researchers, and the location of most of the referent groups for the study.

### III.1.2 - Research Questions and Propositions

Although this study was primarily exploratory in nature, three research questions were developed to guide the development of the instruments and to give direction to the analysis.<sup>3</sup> Three propositions were derived from these questions and from Douds and Rubenstein(1966). The three research questions and propositions associated with them as they are presented in HINDSIGHT "First Technical Report" (Rubenstein,1966(c)) Appendix B, Liaison Relations, are shown below:

1. How are organizational interfaces characterized in R and D?

Proposition 1: Increases in physical and geographic barriers will decrease the frequency of communication, decrease the number of people engaging in interface communication, and tend to decrease the ratio of interactive to non-interactive communication.

2. What are the characteristics of interface communicators or liaison agents?

Proposition 2: A person filling the role of "liaison agent" must be perceived as an active member of a working group in order to be perceived as an effective liaison agent for that group.

3. How do interfaces change with organizational stress?

Proposition 3: During project crises, interface communications will increase as the perceived urgency increases and organizational controls are changed.

Using the same research questions, the propositions were modified slightly to make them somewhat more explicit. A clarified form of each proposition is presented below:

Proposition 1: As physical and geographic barriers increase, other things being equal,  
a. the frequency of (interface) communication decreases.  
b. the number of people engaging in interface communication decreases.  
c. the ratio of interactive to noninteractive (interface) communication decreases.

Proposition 2: Perception (by the group members) of a liaison agent as an active member of a working group is a necessary condition for perception of him (by the group members) as an effective liaison agent for that group.

Proposition 3: Given the situation of project crisis, changes in (the amount of) interface communications will be positively related to:  
a. changes in perceived urgency.  
b. changes in instability of organizational controls.

Proposition 1 is certainly not an original proposition and has been verified by many researchers in a variety of settings. (See Merton,1948; Caplow and Forman, 1950; Festinger, Schacter and Back,1963; Gullahorn,1952; and Maisonneuve,1952 to name a few.) It is appropriate to investigate it in this study for at least two

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<sup>3</sup>The research questions and initial propositions were developed by C.F. Douds, Northwestern University.

reasons. One reason is that we would like to replicate findings in as many different kinds of situations as possible. In this case, since the finding that communication frequency is inversely related to distance is already rather well-verified, whether or not this instrument shows the same finding may give some indication as to whether the instrument is providing feasible data. Another reason is, of course, that one would like to know whether the phenomenon actually holds in this particular setting.

A problem arises, however, if the data were to show no relationship. Since the inverse relationship between distance and communication frequency is a rather well established finding, and since one may have doubts about the accuracy of this type of retrospective data, it would be difficult to interpret whether the instrument and data collections procedures were faulty, or whether the relationship truly does not hold in this particular situation. On the other hand, an affirmative finding would tend to confirm both the proposition and the instrument as valid. Until more is known about the quality of retrospective data, this ambiguous problem is likely to remain. Although an affirmative finding could be explained in other ways, since the relationship is so well- and widely-verified, one's confidence in the instrument would certainly increase with a finding which replicates previous results.

The restatement of Proposition 2 shows that the proposition is predicting a necessary condition for perception as an effective liaison agent. The appropriate procedure for testing such a prediction is to identify the effective liaison agents and then to ascertain whether the predicted necessary condition exists (Zetterberg, 1965, p.138). In the ideal case, one instance in which A (an effective agent) exists without the hypothesized necessary condition B (perception as member) is sufficient grounds to disprove the proposition. It is unlikely however, that one is dealing with an "ideal" case in much of social science research. Particularly in light of the problems of retrospective data, it would seem reasonable to look for a less pronounced relationship than the necessary condition stated in the proposition. It would be encouraging to further research if some positive relationship could be detected between perception as a member and perception as an effective liaison agent.

The restatement of Proposition 3 emphasizes that a project crisis must be identified before it is feasible to test this case. The proposition as stated does not hold for the condition of no project crisis. The term "amount of communication" is rather ambiguous. Communication might be measured in terms of frequency, number of channels, amount of information transferred per time unit, and in other ways. In the interview, the respondent was not asked to specify how he interpreted the "amount of communication," but he was asked to supply judgments as to how this varied. Not only may the lack of common definition make the data incomparable between respondents, but the proposition itself may be affected. Proposition V of the model predicts a decrease of interface communication channels during crisis, but an increase in the frequency. It may be that further research along these lines will indicate the need for differentiation among the many factors that contribute to the "amount of communication."

### III.1.3 - Comments on Data Collection

Data for Project HINDSIGHT were collected by in-house personnel and were then transmitted to the participating institutions for reduction and analysis. Before beginning data collection, the collectors attended an intense two-week

training course which attempted to expose them to elements and problems of field research and data collection. It was not intended to develop these persons into experts in the area of social science research, but it was hoped that they became aware of potential and real problems which they might encounter. They were familiarized with the questions being addressed by the study although there was no attempt to indoctrinate them in extensive theory leading to these questions.

The interface section of Project HINDSIGHT consisted of two instruments,<sup>4</sup> an interview and a questionnaire. (See Appendix B for sample copies.) This questionnaire attempted to identify the persons and groups associated with a particular designated event. The questionnaire was completed by a representative group of persons who had been in the referent group at the time of the event. This usually meant that three or four persons completed the questionnaire. These persons were selected as impartially as possible by the in-house researcher. He was limited to some extent in his choice because the events often occurred ten or more years ago and many persons could no longer be contacted for one reason or another. The effect of biased representation of the event is not calculable, though there is little reason to suspect that this would have a pronounced effect on the data. Only if there were reason to believe that those persons who had died or who were otherwise unavailable were in some way consistently different from those who completed the questionnaire would there be substantial basis for a claim of selection bias. Attempts were made to reach persons who are now employed elsewhere. Although these were not completely successful, this tended to reduce such possible differences.

The most noticeable shortcoming of the data collection procedure is the fact that data were collected in retrospect. Respondents were asked to recall rather specific details of events that occurred up to fifteen years ago (1952), although some of the more recent events occurred in the early 1960's (1960-1962). It is difficult to intuitively assess the effects of this retrospective type of data-collecting. (See O'Keefe, 1966.) There seem to be at least two plausible ways in which the data might be affected. One possible bias is that respondents would recall only unusual incidents and interpret these as the normal situation. This bias might be called a type of "halo effect" in which an entire event or series of relationships is colored in the respondent's mind with one or a few particularly good or particularly bad incidents.

A second bias might enter if the respondent realizes that he is unable to accurately recall the actual occurrences and attempts to "assist" his memory in some way by generalizing to the desired event from his experiences. In this case, the respondent might attempt to provide information which he believes the researcher is looking for, or he might simply make an educated guess as to what really occurred on the basis of his experiences in many events of this sort. The bias toward "satisfying" the researcher by providing him with the information he wants may be affected by the researcher's position in the organization and the relationship which exists between the researcher and the respondent. In both the sites analyzed in this study, the researcher was in a staff or administrative position not directly superior to the persons being interviewed. In at least one case which was observed by the writer, the relationship between the researcher and the respondents tended to be one of friendship and mutual cooperation.

It is not thought that researcher position or personality ~~per se~~ had any adverse effects on the data collection. However, the two basic biases described

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<sup>4</sup>Both instruments were designed by C.F. Douds, Northwestern University.

above - the halo effect and the assisting-the-memory effect - are biases which are not calculable by an outside observer unless the observer happens to have some information about the event under study from another source. This was not the case in this study and one can only guess as to the impact of these biases on the data. To give some direction to the estimates of these biases, two questions about the relevance of the questionnaire were included in the instrument. Respondents were asked to indicate whether the questionnaire gave an accurate or inaccurate picture of the actual circumstances of the event (Question 30), and they were given the opportunity to add any comments of their own which had not been tapped by the questionnaire in a "free-for-all" question (Question 31). The general consensus of the responses to these questions is that the questionnaire was "so-so" in its accuracy. There were several comments mentioning the difficulty of remembering what actually occurred.

As mentioned above, the instruments used to collect the data for the interface portion of Project HINDSIGHT consisted of a questionnaire and an interview. The questionnaire was designed to be self-administered and attempted to obtain information concerning the persons and groups involved with a particular event during a specified time period. A reference group was identified which was the prime group responsible for the research work done on the event. Usually three or four members of this reference group completed the questionnaire. Some time after the questionnaires for a given event were completed, several persons who were identified through the responses to the first five questions of the questionnaire were administered interviews. For each event there were usually five or six completed interviews available, although this number ranged from two to ten. (In several cases it turned out that persons who were identified by the questionnaires were associated with the event only slightly and could not supply sufficient information to complete the interview.) The interview followed an interview guide and usually took in the neighborhood of one half an hour to administer. The primary information supplied by the interview concerned the respondent's perception of the effectiveness of various persons as communicators and whether certain persons would have been accepted as members of the referent group. Additional information supplied by the interview concerned changes in control, project urgency, and crisis which may have occurred during the event.

#### III.1.4 - Identification and Definition of Variables

The list below identifies variables referred to in the discussion of the research questions and propositions. Definitions are provided for each variable.

- 3.1-Barriers: obstacles which impede the free flow of ideas, general communication and cooperation.
- 3.2-Physical and geographic barriers: those barriers caused by nonpersonal environmental factors such as distance, weather conditions, walls, desks, and closed doors.
- 3.3-Communication: the imparting or interchange of information
- 3.4-Interface communication: communication across the boundaries of work groups
- 3.5-Work group: a cluster of individuals working on a single (or closely related) set of activities.

- 3.6-Frequency of communication: the number of times in a given time period in which communication occurs across the boundaries of a group.
- 3.7-People engaging in interface communication: persons who are recipients and/or transmitters of interface communication.
- 3.8-Interactive communication: face-to-face, telephone, or other types of communication in which immediate feedback and/or interchange of information is possible.
- 3.9-Noninteractive communication: communication in which immediate feedback and/or interchange of information is not possible.
- 3.10-Ratio of interactive to noninteractive communication: the portion of a person's communication which is classified as interactive divided by the portion classified as noninteractive.
- 3.11-Liaison role: a role, formal or informal, whose intended function is to prevent or overcome imperfect interface communication.
- 3.12-Liaison agent: any person who acts in a liaison role.
- 3.13-Perception as an active member: the degree to which an individual is (would have been) accepted by his co-workers as belonging to a work group.
- 3.14-Perception as an effective agent: the degree to which group members perceive a liaison agent as enhancing information exchange.
- 3.15-Project crisis: a time period of substantially greater importance in the life of a project than other comparable time periods.
- 3.16-Perceived urgency: an individual's perception of the immediacy with which a solution is needed by the organization.<sup>5</sup>
- 3.17-Instability of organizational controls: the degree and rate to which organizational procedures, rules, and practices are changed.

As has been previously noted, communication is a very complex process involving many intervening variables which are not readily measurable or observable by third persons. For example, a very real part of face-to-face communication is the gestures and facial expressions of the communicators. In verbal communication, slight nuances of voice and pauses are important in conveying information. Although verbal communication may not always be more informal than written communication (e.g., compare the informal memo and the formal conference), one generally expects that there is a greater opportunity for immediate feedback and interchange of information in verbal communication. It is on this basis that communication is divided into two broad classes of interactive and noninteractive. One would usually expect a given instance of interactive communication to be more conducive to complete understanding by both parties and thus be preferred, but this is not necessarily always so. The division of communication into interactive and noninteractive must be viewed as an arbitrary selection of criteria. Communication could probably be more accurately viewed as a continuum from heavily interactive to completely noninteractive on the basis of immediacy of feedback. The selection of an arbitrary dividing point will of necessity

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<sup>5</sup>Adapted from HINDSIGHT "First Technical Report" Appendix B, Idea Flow, p.3.



result in some errors because other things affect the degree of interaction besides the immediacy of feedback.

### III.1.4.1 - Sources of Information About Variables

The table which follows (Table 3.1) indicates which portion of the instruments provides data for the variables. The prefix "Q" refers to the questionnaire and "I" refers to the interview. In addition to the specific sources, background information about the history of the sites was incorporated. Also valuable was Question 31 of the questionnaire which provided miscellaneous information relevant to several of the variables.

VARIABLE	SECTION OF INSTRUMENTS PROVIDING DATA
3.2-Physical and geographic barriers	Q14
3.4-Interface communications	I2b, I4, Q15, Q16, Q17, Q18
3.6-Frequency of communication	Q23, Q24, Q25, Q26, Q27
3.7-People engaging in interface communication(number)	Q20, Q21
3.10-Ratio of interactive to noninteractive communication	Q23, Q24, Q25, Q26, Q27
3.12-Liaison agent	Q22, I2a, I5
3.13-Perception as an active member	Q2, Q5, I2c
3.14-Perception as an effective agent	I2b, (Q31)
3.15-Project crisis	I3, I4
3.16-Perceived urgency	I4
3.17-Instability of organizational controls	I4, I5

TABLE 3.1  
Information About Variables

### III.1.5 - Data Reduction and Analysis of Propositions

Data from two HINDSIGHT sites were available for analysis comprising a total of 46 questionnaires and 95 interviews. Of these instruments, 5 questionnaires and 14 interviews were not useable because the respondent was not fully connected with the event and could not supply appropriate answers. This left a net total of 41 questionnaires and 81 interviews representing 16 events. See Table 3.2 for a breakdown of the instruments.

SITE	INSTRUMENTS COLLECTED	INCOMPLETE INSTRUMENTS	NET TOTAL INSTRUMENTS	EVENTS REPRESENTED
A	16 Quest.	2 Quest.	14 Quest.	5
A	15 Inter.	0 Inter.	15 Inter.	
B	30 Quest.	3 Quest.	27 Quest.	11
B	80 Inter.	14 Inter.	66 Inter.	
			41 Quest.	
			TOTAL 81 Inter.	TOTAL 16

TABLE 3.2  
Instruments Collected

The initial step of data reduction was accomplished with the aid of two computer programs written specifically for this study by C.F. Douds. The first, Pro-

gram PRECMR, rearranged the data so that various groups could be identified even though different respondents referred to them by different names. In doing this respondents were grouped by event and the group names used by each respondent were printed. The groups were classified on the basis of whether they represented input, coordinative, or output interfaces with the referent group. This further aided in identifying multiply-named groups. Groups named in questions 6 through 9 were classified as input groups; questions 10 and 11 identified coordinative groups; and output groups were named in questions 12 and 13. (See Appendix A for a sample output sheet from this program.)

The PRECMR program was valuable in allowing identification of groups and in determining the relative role each group played in relation to the referent group, but it did not form the basis for any of the analysis. Program INTERFAC was the second step in the data reduction by computer. This program completed the error checking started by PRECMR and in addition rearranged much of the data used in the analysis of the first proposition. INTERFAC provided error checking for questions 14 through 28 and manipulated these same data. The output of this program was a set of matrices plotting distance versus several other variables. It was possible to obtain the output either in terms of individual events or combined into a single matrix representing all events. It was found that for the most part, the combined mode was most useful in this analysis, but the flexibility of the program in this regard is valuable for future studies.

These data were both a test of Proposition 1 and an exploratory search for other significant relationships. (The exploratory portion of the study is described more fully in a subsequent section.) It would be useful if further modifications of INTERFAC would provide slightly more flexibility by allowing the user to designate the variables to be used for computing the matrices.

### III.1.5.1 - Proposition 1

For the sake of convenience, it is appropriate to restate Proposition 1 here:

Proposition 1: As physical and geographic barriers increase, other things being equal,

- a. the frequency of (interface) communication decreases.
- b. the number of people engaging in interface communication decreases.
- c. the ratio of interactive to noninteractive communication decreases.

There are four variables which must be identified and measured in order to evaluate this proposition. They are:

- (1) physical and geographic barriers (3.2)
- (2) frequency of interface communication (3.6)
- (3) number of people engaging in interface communication (3.7)
- (4) the ratio of interactive to noninteractive communication (3.10)

#### --Physical and geographic barriers (3.2)--

The primary source of information about barriers was from question 14 shown below in Fig. 3.1. In some cases, additional information was contained in the interviews, but this was not consistent enough to be of much assistance. The most interesting contribution of some of the interview data regarding distance was the lack of agreement in some cases on such an objective factor as the physical distance separating two groups, or the absolute location of the groups. For example,

one respondent comments that "...the Analysis and Measurement Branch moved to a building approximately one mile away which tended to reduce the freedom, amount, and quality of communication." Another of the members of the same group contradicts him by reporting "...all groups in same building so there were no serious physical constraints on communication." In this particular case several other group members corroborated the latter statement and it appears that the first statement is in error. This finding of direct contradiction is not too frequent with regard to physical distance, but the fact that it does occur occasionally on a factor that is a fairly objective one indicates the necessity to interpret this kind of retrospective data with caution. In general, the data on physical distance agrees fairly well across respondents in answer to question 14. (See listing, Appendix A.) It is not always as consistent for less objective phenomena.

- 
14. What was the physical "distance" to the group from your location?  
If moves occurred, write in as many codes as necessary.
- A - Same room or only a few steps away.
  - B - "Down the hall;" a few minutes away.
  - C - On a different floor; a few minutes away.
  - D - In a nearby building; several minutes away.
  - E - "Across town;" a fraction of an hour or an hour away.
  - F - In another town; more than an hour or so away.
- 

Fig. 3.1, Question 14

--Frequency of communication (3.6)--

The frequency of communication was obtained from the responses to questions 23 through 27 (Fig. 3.2). The reasoning was that physical distance would set an upper bound on the frequency of communication; therefore, the maximum frequency mentioned in these five questions was used in the frequency versus distance matrix. Questions 23 through 27 are shown below:

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23-27. Please use the following scale for this group of questions.

- A - Several times a day.
- B - Several times a week.
- C - About once a week.
- D - About once a month.
- E - Less than once a month.
- F - Never.

Approximately how often was there communication between your group and the others listed--

- 23. At formal conferences and meetings?
  - 24. Through an intermediary, not a member of either group?
  - 25. By personal, face-to-face conversations?
  - 26. By written notes, memos, letters, reports, or transfer of documents?
  - 27. By telephone?
- 

Fig. 3.2, Questions 23 - 27.

These questions were answered for each group which the respondent had mentioned earlier in the instrument as being a group with which the referent group had contact of one sort or another.

--Number of people engaging in interface communication (3.7)--

Questions 20 and 21 respectively asked how many people from the referent group were in contact with each other group and how many persons in other groups were in contact with the referent group. There was provision for responses to indicate variation over the life of the event, but most respondents gave only one answer. Where two or more answers were given, most of the variations were by only one or two persons (e.g., 2/2/1). The two questions are shown in Fig. 3.3. Responses from each of these questions were plotted separately against distance. Then the two questions were combined and the total number communicating was plotted against distance.

- 
20. How many people from your group were in (more or less) regular contact with each group? If significant variations occurred in the initial, mid, and end time periods give three numbers--e.g., 2/8/1.
21. How many people in each group were the (more or less) regular recipients of these contacts? Indicate significant time variations in the same manner.
- 

Fig. 3.3, Questions 20 and 21

--The ratio of interactive to noninteractive communication (3.10)--

Questions 23 through 27 provide the data for the computation of the ratio of interactive to noninteractive communication. In the program, questions 23, 25, and 27 are considered as representing interactive communication and questions 24 and 26 represent noninteractive communication. Responses to the questions are assigned numerical values of six, five, ... zero corresponding to the letters A through F respectively. The ratio is then computed and assigned to a category ranging from high to low. The cutoff values are shown in Fig. 3.4. (On the printout sheet, the term "direct/indirect" is used rather than interactive/noninteractive.)

If ratio is greater than:	but less than:	the category is:
7.37	---	1 (high)
3.60	7.38	2
1.76	3.61	3
.86	1.77	4
.43	.87	5
---	.44	6 (low)

Fig. 3.4 Cutoff points for ratio of  
Interactive to noninteractive communication

--Analysis of Proposition 1--

It was found that the matrices obtained for individual events contained very few entries, often being as low as three or four entries for a 7 by 9 matrix. Rather than analyzing the data for each individual matrix in each event, it was felt to be more feasible to combine the events to obtain a total of five matrices relevant to this proposition. This is felt to be an appropriate procedure since the phenomena being investigated are claimed to be general trends which will occur

		Distance				
		low		high		
Number Contacting	>8					3
	8	1				
	7					
	6					2
	5	2	3	2	3	11
	4	1	2	2	1	4
	3	2	3	5	12	17
	2	4	9	8	13	10
	1	5	7	5	12	26

Fig. 3.5

		Distance				
		low		high		
Number Contacted	>8	1			1	4
	8	1				
	7					
	6					4
	5	1	4	1		6
	4	2	4	2	3	1
	3	2	7	8	8	7
	2	5	6	2	12	13
	1	5	4	9	22	2

Fig. 3.6

		Distance				
		low		high		
Total Number Communicating	>16					
	16					
	14				2	
	12				1	3
	10		3			3
	8	2	1	5	1	5
	6	2	9	1	8	15
	4	3	6	8	14	18
	2	2	6	8	15	26

Fig. 3.7

		Distance				
		low		high		
Maximum Frequency	high	7	8	4	4	5
		7	7	8	9	1
		1	3	6	12	1
		2	4	3	10	2
			4	1	12	2
	low					1

Fig. 3.8

		Distance				
		low		high		
Ratio of Interactive Noninteractive	high	5	2		2	6
		5	8	9	16	3
		6	14	10	19	2
		1		2	9	1
	low					1

Fig. 3.9

across all groups and all events. No distinction was made between sites, all the data being treated as if from one site. Because the sites are similar in organization and because this proposition is attempting to describe a general phenomena, it is not felt that this procedure was inappropriate. Visual inspection of the printout sheets did not reveal noticeable differences in the relevant matrices.

The data used in evaluating the proposition are shown in Fig. 3.5 through Fig. 3.9. The data were analyzed in terms of Chi-square contingency tables. Fig. 3.10 shows that three of these relationships are significant at the 0.025 level or better. That is, the null hypothesis of independence between the two variables is rejected in three of the five cases. Examination of the tables indicates that the dependence between the variables is in the direction predicted by the proposition. For example, the dependence between communication frequency and physical

distance is in the direction of higher frequency the shorter the distance. The dependence between the ratio of interactive to noninteractive communication and physical distance is in the general direction predicted, but it should be noted that there was a definite clustering of the ratios in the middle area of the ratio scale. The data indicate a slight trend in the predicted direction, but further research should be done to verify this finding.

Relationship: Distance versus--	Chi-square Required	Chi-square Obtained	Significance Level
Number Contacting	46.0588	34.9007	NS*
Number Contacted	69.1986	72.1198	0.005
Number Communicating	40.2560	35.7247	NS*
Maximum Frequency	46.9279	49.8918	0.005
Ratio of Interactive to Noninteractive	34.1696	34.2596	0.025

\*NS (not significant) relationships were tested at the 0.10 level.

Fig. 3.10 - Summary Findings

The table and the matrices indicate that the frequency of communication and the ratio of interactive to noninteractive communication decrease as physical distance increases. These findings tend to verify Proposition 1, parts a. and c. Also indicated is that the number of people contacted in the other group decreases as physical distance increases. However, the other two figures (Fig. 3.5 and 3.7) concerned with the number of people communicating are not significant even at the 0.10 level. This would tend to lead to an interpretation which rejects part b. of Proposition 1.

It is not clear why there should be a significant relationship between physical distance and the number of people contacted in another group and no relationship between physical distance and the persons in one's own group who communicate. It is possible that the collection of data in retrospect may have some bearing on this finding. It may be that one simply remembers one's own group better and can remember instances when almost everyone did some communicating with other groups. One would not be so likely to remember persons from another group except those who were frequently noticed, probably those persons who were key persons and did a lot of communicating with one's own group. Thus, assuming that there actually exists an inverse relationship between number of persons communicating and physical distance (similar to those found for the other dependent variables), an hypothesis of "differential remembering" due to group membership would explain the finding described. The fact that the total number of people communicating was not found to be significant is not too surprising when one recalls that this is a composite relationship, composed of the same data from which Fig. 3.5 and Fig. 3.6 were



part it was not possible to pinpoint one or a few key persons.

(Differences between information received from the two sites became noticeable in data pertaining to this proposition and the third proposition. One researcher was obviously aware of the propositions and obtained considerable information on individual perceptions of who were liaison agents, how effective they were, and whether they would have been accepted as members. However, this researcher accounted for only about twenty percent of the data. The second researcher supplied much more data, but much of his interview data was not detailed enough to identify liaison persons as clearly as was possible with data from the other researcher.)

Question 22 indicated whether a liaison arrangement existed between groups, and the nature of such an arrangement, but it did not identify who filled the liaison function(Fig. 3.12). The procedure which was finally used to locate liaison persons was to identify those persons who were chosen by at least half of the interviewees (with respect to a given event) as having carried information back and forth among two or more groups. (See I2a, Appendix B.) This was considered a minimum criteria for a liaison person. Those persons who were also mentioned in the body of the interview as having been key persons or having performed a liaison function were starred (\*) in Table 3.3 and identified as true liaison agents. Since there were only three of these persons, it is not possible to ascertain whether they have characteristics markedly different from the others who were treated in the analysis as liaison agents.

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22. With which groups were there formal "liaison arrangements" of the following types--

- A - A supervisor, manager, special assistant, etc., from a point in the organization above the supervisor of both groups.
- B - A "liaison agent" not responsible to a supervisor in either group.
- C - A member of one group designated as the "contact man" for the other group.
- D - A member of one group assigned to work at least part time in the other group.
- E - None of the above liaison arrangements.

---

Fig. 3.12, Question 22

Using this method, twenty-seven liaison agents were identified. It should be noted that all of these liaison agents refer to persons who were not organizationally defined as part of the referent group. The main reason this is so is that no respondent was asked whether he would accept members of his organizationally defined group as members of his work group. In other words, it was assumed that the members of the organizationally defined referent groups accepted each other as members. In order to test Proposition 2, it is necessary to have responses as to whether or not a particular person was accepted as belonging to the respondent's work group. These responses were available only for persons in organizationally defined "other" groups and thus the proposition was tested only on these persons. The situation may be restated in a simpler way: By assuming that persons accepted individuals in their organizationally defined group as work group members, one has guaranteed that the proposition cannot be disproven for one's own organizational group. Therefore, the proposition must be tested in a situation in which both the



variables may vary. For this reason, only liaison agents from the "other" groups were identified.

--Perception as an active member (3.13)--

As has been previously mentioned, whether or not a person was accepted as a work group member was determined only for persons who were not part of the organizationally defined group. These responses were obtained in question 2c of the interview. Additional data were sometimes available as supplementary indicators in questions 2 and 5 of the questionnaire, but these data were not significantly helpful.

Number Interviewed	Acceptance As Member	Effectiveness Rating **
* 4	4 yes	3.0 (2)
5	3 yes	3.0 (2)
6	3 yes	2.8 (4)
10	4 yes, 4 no	2.8 (8)
5	4 yes, 1 no	2.8 (4)
* 8	4 yes	2.8 (4)
8	2 yes	2.8 (4)
10	4 yes, 4 no	2.7 (7)
8	3 yes, 1 no	2.6 (5)
5	2 yes, 1 no	2.5 (4)
* 5	3 yes, 1 no	2.5 (4)
8	3 yes, 2 no	2.4 (5)
5	2 yes, 1 no	2.3 (3)
8	3 yes, 1 no	2.3 (4)
8	4 yes	2.3 (6)
7	3 yes, 2 no	2.3 (4)
10	4 yes, 4 no	2.1 (7)
8	1 yes, 3 no	2.1 (3)
5	5 yes	2.0 (2)
5	3 yes	2.0 (2)
8	2 no	2.0 (3)
5	1 yes, 2 no	2.0 (4)
7	2 yes, 5 no	1.8 (5)
7	2 yes, 5 no	1.6 (5)
5	1 yes, 2 no	1.6 (5)
5	3 yes	1.5 (2)
8	3 yes, 1 no	1.5 (6)

\*definite liaison agents

\*\*number rating this person

TABLE 3.3 - Liaison Effectiveness and Acceptance

The principal problem involved in analyzing the data on the independent variable was how to collate the data into a representative rating for a given individual. The crucial decision was what to do with the persons who gave no response to this question. It was finally decided to ignore the persons who gave no response and summarize the data on the basis of those who did respond. (This procedure is similar to the one used to summarize the ratings of effectiveness.) This decision makes the assumption that the unknown responses would have made little difference in the final scores. Any other decision would have to make some assumption about the ways in which the unknown scores would have altered the final scores. There do not appear to be grounds for any trend of the unknown scores in one particular way rather than in another way.

The acceptance scores were summarized in terms of the percent who would have accepted out of those who responded to the question for a given event. The total range of the scores went from 00% to 100% with a median of 75%. The range was then divided into the sections of high (greater than 75%), medium (less than or equal to 75% but greater than 50%), and low (less than or equal to 50%). This division resulted in categories with frequency ten, eight and nine respectively.

--Perception as an effective liaison agent (3.14)--

The primary source for data on the effectiveness of various persons in communicating was interview question 2b. (See Appendix B.) Occasionally question 31 from the questionnaire provided additional data, but this was the exception. The responses to question 2b were found to conveniently fall into the categories of Very Effective, Moderately Effective, Slightly Effective, and Ineffective. These were assigned arbitrary numerical values of 3,2,1 and 0 respectively and an average rating of effectiveness was obtained for each liaison agent. The rating was an average only of the persons who had rated him, not for the entire number of interviewees for a given event. In the "Rating" column in Table 3.3, the number in parentheses is the number of persons who rated the liaison agent. This can be compared to the number interviewed and be seen to usually be one-half or greater of the number interviewed.

The ratings ranged from 1.5 to 3.0 with a median of 2.3. In order to construct a contingency table, the data were divided into categories of high (2.5 through 3.0), medium (2.0 through 2.4) and low (less than 2.0).

--Analysis of Proposition 2--

There were a total of seven scores which fell exactly on a dividing point (four scores of 75% and three scores of 50%) in the range of acceptance scores. Since these scores represented one-fourth of the total number identified as liaison, it was quite important which way they were classified. The contingency table in Fig. 3.13 was analyzed to determine if the null hypothesis of independence between acceptance as a member and perception as effective could be rejected. It was found that it could not be rejected at the 0.10 level (i.e., the relationship was not significant). It turned out however, that the seven scores on the dividing points of the ranges of high, medium, and low would have changed the significance if they had been classified into the upper categories rather than the lower categories. Therefore, the graph in Fig. 3.14 is included in order to present a slightly clearer picture of the actual relationship between the variables.

The data pictured in the graph were subjected to a correlation analysis. The resulting correlation was found to be 0.43, significant at the 0.025 level. Although this must be tempered with the finding that the relationship is, at best, only mar-

Effective- ness	High	2	3	6
	Med.	4	4	3
	Low	3	1	1
		low	high	
		Acceptance		

Fig. 3.13 Effectiveness  
versus Acceptance

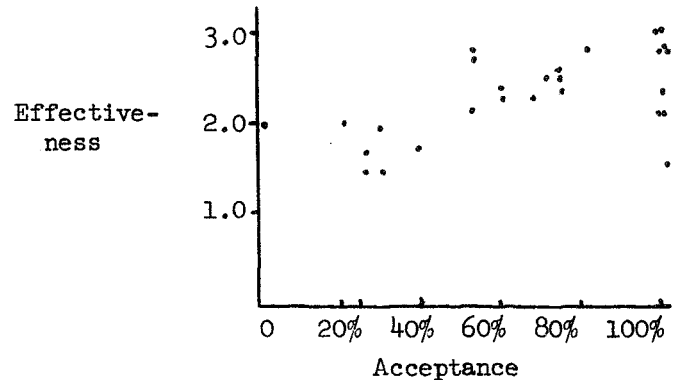


Fig. 3.14 Effectiveness  
versus Acceptance

ginally significant in terms of the contingency table analysis, it does seem to indicate that there is some sort of marginal basis for support of Proposition 2. At the very least, there should be further research undertaken to more clearly verify or disprove the proposition.

The proposition predicts that acceptance as a member is a necessary condition for perception as an effective agent. The findings do not support that strong a statement, but they indicate a possible relationship between acceptance as a member and effectiveness. The direction of causality between these two variables is uncertain. A plausible argument can be made for an interpretation in both directions. It would seem likely that this relationship is of the kind Berelson and Steiner (1964) call a spiral relationship in which more of A leads to more of B which in turn leads to more of A and so forth.

### III.1.5.3 - Proposition 3

The revised form of Proposition 3 is stated below:

Proposition 3: Given the situation of project crisis, changes in (the amount of) interface communication will be positively related to:

- a. changes in perceived urgency.
- b. changes in instability of organizational controls.

It is necessary to identify these variables:

- (1) project crisis (3.15)
- (2) interface communication (3.4)
- (3) perceived urgency (3.16)
- (4) instability of organizational controls (3.17)

#### --Project crisis (3.15)--

All data relating to crisis conditions during the project were obtained from the interview questions three and four (Fig. 3.15). These two questions were fairly effective in eliciting information about crises although responses of different persons from the same group were often not consistent. Table 3.4 is included in the presentation to indicate the magnitude of some of these inconsistencies. The entries in the table refer to persons who specifically stated that there was no crisis during the project versus those who described a crisis.

Most of the persons who described a crisis described a technical crisis of

some sort. Although several persons mentioned reorganizations in passing, most of them remarked that this had not had any noticeable effect on the project or the referent group. There were some exceptions to this observation as in the case of one group which was completely dissolved in the midst of a project because of increased effort in other areas in the post-Sputnik era. Generally however, the crises recalled were concerned with technical problems or disagreements as to technical capabilities or qualifications. There were virtually no remarks concerning personality differences which resulted in crises (only one out of eighty-one interviews).

---

3. When did periods of crisis occur with respect to:

- technical work of the interviewee's group?
- technical work affecting the whole program or organization?
- management of the program or organization?

4. Elicit a number of incidents that involved the interfacing groups where there was an observable outcome that was:

- clearly successful (constructive or "good").
- clearly unsuccessful (disruptive or "bad").

Include normal or everyday situations as well as crisis situations. Comparing everyday and crisis situations, note in as much detail as possible remarks indicating:

- changes in amount of communication between groups;
- changes in ability or freedom to communicate, imposition or relaxation of controls;
- changes in felt urgency.

---

Fig. 3.15, Interview Questions 3 and 4

--Interface communication (3.4)--

For this proposition, it was necessary to know how the amount of interface communication varied during periods of project crisis. This information was obtained primarily from interview question 4 (Fig. 3.15). Other information about how the amount of information varied with time was obtained from questions 15 through 18 in the questionnaire (Fig. 3.16), but these questions referred to communication in general between the referent group and other groups. It did not pertain specifically to periods of crisis.

Referring to Table 3.4, it can be seen that the information requested in interview question 4 was not as complete as would have been desirable. In order for this proposition to be correctly evaluated, it is necessary to have complete responses to this question.

Group	Number Interviewed	Project Crisis		Amount of Communication			Perceived Urgency			Instability of Organizational Controls Freedom to Communicate			Formal Liaison		
		Yes	No	Incr	Same	Decr	Incr	Same	Decr	Incr	Same	Decr	Yes	No	Circumvention
1	8	3	2	1	3	3		6			4			7	
2	7	2	2	1	3	2	1	3	1		2			6	
3	6	3			2	1	1	3			2		4	2	
4	8	2	1		2	1	2	5			2	1		3	1
5	4	4			1									2	
6	5	4	1	1				1							1

TABLE 3.4

Characteristics of Groups with Identified  
Project Crisis

---

15. With what group(s) did you have--

- M - The most communication
- L - The least communication
- A - Roughly average amount of communication relative to M and L.

16-18. How did the amount of communication between your whole group and each of the named groups vary during the period of work on the Event? (Same code as above.)

- 16. During the initial period (often the first  $\frac{1}{4}$ )?
- 17. During the mid period (often the middle  $\frac{1}{2}$ )?
- 18. During the end period (often the last  $\frac{1}{4}$ )?

Please date the periods you had in mind:

Initial: \_\_\_\_\_ to \_\_\_\_\_

Mid: \_\_\_\_\_ to \_\_\_\_\_

End: \_\_\_\_\_ to \_\_\_\_\_

---

Fig. 3.16, Questions 15-18

--Perceived urgency (3.16)--

The main source for information concerning the urgency of the project as perceived by group members was interview question 3. The responses to this question were also sketchy as shown by Table 3.4. There was somewhat more agreement on this question than on whether or not a crisis occurred. Responses to this question were categorized as increasing urgency, decreasing urgency, or no change in urgency.

--Instability of organizational controls (3.17)--

Responses to interview questions 4 and 5 were analyzed to determine the stability of organizational controls. Organizational controls were said to be stable if there was little or no change in perceived freedom to communicate, and if formal liaison arrangements were not circumvented. To the extent that freedom to communicate varied and formal liaison arrangements were circumvented, organizational controls were interpreted as instable.

Table 3.4 shows that there were virtually no responses which indicated a change in perceived freedom to communicate. Also, there were very few responses indicating that circumvention of formal arrangements occurred. Most of the respondents felt that there was always high freedom to communicate and that informal communication was encouraged. Supplementing this impression were the many statements that the respondents were not aware of any formal liaison arrangements. Whether there actually were formal arrangements, or whether these arrangements were carried out and considered by the group members as informal is not interpretable from the data.

--Analysis of Proposition 3--

Although data did not appear to be completely adequate to test the proposition properly, a preliminary attempt was made to see if there seemed to be a basis for

further research on this topic. Table 3.4 shows in summary form the data on urgency and stability of organizational controls for six groups which were defined as having experienced a crisis during the project. A crisis was said to exist if at least half of the respondents who answered the question indicated that there was a crisis. This was a weak criterion and may have resulted in some groups being classified as having undergone crisis when they did not actually do so. However, this appears to be the most feasible way of approaching the proposition given the data available.

While Table 3.4 does not appear to demonstrate any pronounced relationship as predicted, a reading of the interview tends to lend support to the proposition as stated. A quotation from one of the members of group 6 is shown below:

At that time, the heavy work load of A [the referent group] contributed to a desire to get as much work as possible out of C [a testing group]. When special 90-day programs were superimposed, a much closer relationship developed. Groups were much more harmonious, worked better together to meet a deadline. All work on other projects was dropped.

This statement and other similar statements tend to support the interpretation of the amount of communication increasing as perceived urgency increases. Unfortunately, the data is such that only a few descriptive statements of this type were collected. The data are not sufficient to make any quantitative statements about the relationships predicted in Proposition 3.

A supplementary analysis was undertaken of questions 16, 17, and 18 to determine if any typical pattern of the amount of communication over the life of the event could be detected. Since each of these questions could be answered by one of three answers, there were a possible twenty-seven different patterns of the amount of communication which could be reported. These patterns were classified into five groups on the basis of whether they represented the same amount of communication over the event, an increasing amount, a decreasing amount, a concave pattern or a convex pattern. Table 3.5 shows the patterns included in each category and Table 3.6 shows the distribution of the patterns for each referent group. A visual inspection of Table 3.6 indicates that there does not seem to be any marked difference in the communication pattern between groups who experienced a crisis and those who did not. It should be remembered however, that both the method for determining crisis and the classification of the patterns into these five large categories are rough indicators and not to be taken as precise measures.

#### III.1.5.4 - Other Findings and Analyses

In addition to investigating the effects of distance in Proposition 1, matrices were computed to plot physical distance against several other variables. The matrices are shown in Fig. 3.17 through Fig. 3.21. The variables contributing to these matrices were measured by questions 23 through 27 and were attempts to evaluate the effects of distance on communication by various modes. The different modes represent varying degrees of directness and interactivity ranging from personal, face-to-face conversations to written letters and communication through intermediaries.

Fig. 3.23 shows that all these five matrices indicate a significant relationship at the 0.005 level or better. By inspection, all the relationships are in the

PATTERN	CLASSIFIED AS		PATTERN	CLASSIFIED AS
MMM AAA LLL	No Change	X	MMA MLL MML MAL	Decreasing
AAM AMM LIM LMM LAM LAA LLA	Increasing		AIM MLM AIA MLA MAM	Concave
AAL MAA ALL	Decreasing		AML IML LMA AMA LAL	Convex

TABLE 3.5, Communication Patterns

GROUP	COMMUNICATION PATTERN				
	Incr	No Change	Decr	Concave	Convex
1*	2	7	3	2	1
2*	3	8			
3*	1	7		1	
4*		11			1
5*	6	3	7		1
6*	3	3		2	1
7	5	17	1	1	
8	2	4	5		
9	2	4			2
10	7	4	1		4
11		8	1	1	
12	2	7			2
13	1	6	2		
14	1	11	1		

\*Groups in which crises were identified

TABLE 3.6, Distribution of Communication Patterns



Intermediary Frequency	High						
					3		
		2	2	7	1		7
		1	1	2	6	3	14
Low		14	23	12	37	3	52
		Low			High		
		Distance					

Fig. 3.17

Face-to-Face Frequency	High	5	6	4	1		
		9	6	8	3		
		1	4	5	10	1	5
		2	5	4	11	2	29
			5		21	3	40
	Low			1	1		2

Written Frequency	High	3	8	3	3		4
		6	4	9	8	1	7
		1	1	6	10	1	16
		3	2	3	9	1	24
			6		15	3	16
	Low		5	1	2		8
					Low		High
						Distance	

Fig. 3.19

Telephone Frequency	High					1
		1	4	1	1	2
		2	2	2	6	4
		8	6	17	12	2
		6	11	1	26	2
	Low		3	1	1	2
				Low		High
					Distance	

Fig. 3.20

Conference Frequency	High		1		2	
		2	1	1	2	
		8	4	13	3	1
		4	7	1	4	1
		2	9	3	22	4
	Low	1	5	4	13	1
		Low	High			
		Distance				

Fig. 3.21

	High	5	11	7	10	1	19
		7	14	13	23	5	33
Satisfaction		1	1	2	10		12
							1
					1		1
Low							3
	Low				High		
	Distance						

Fig. 3.22

the direction which would be predicted by an inverse relationship between communication and distance. The relationship between distance and communication by an intermediary, although significant, must be interpreted with caution. Out of 190 responses, 141 of them are seen to be in the lowest category which is "Never," indicating that intermediaries are really seldom used as communicators. It would be well to withhold any judgments about the exact relationship between these variables until a sample with a larger frequency of use of intermediaries is available.

There is an especially strong relationship between face-to-face communication and physical distance. This tends to replicate other studies which have found similar tendencies in diverse settings. While none of these relationships were specifically predicted, they are in agreement with the general intent of Proposition 1 and similar findings elsewhere and are not particularly surprising.

Questions 20 and 21 (Fig. 3.3) were also analyzed with respect to the nature of the interface that existed between the groups. Interfaces were classified as

RELATIONSHIP: Distance versus-	Chi-square Required	Chi-square Obtained	Level of Significance
Intermediary Frequency	32.8013	36.5177	0.005
Face-to-Face Frequency	60.1403	109.4845	0.0001
Written Frequency	52.6197	54.8030	0.001
Telephone Frequency	52.6197	54.4776	0.001
Conference Frequency	60.1403	89.1449	0.0001
Satisfaction	34.3816	18.5325	NS*

\*Tested at the 0.10 level

Fig. 3.23, Summary of Findings

input, coordinative, and output. There appeared to be no difference between the number of persons contacting or the number of persons being contacted across the different interfaces.

--Physical distance and satisfaction with communication--

Fig. 3.22 shows the matrix of physical distance plotted against the satisfaction of the respondent with communication between various groups. Measures of satisfaction were taken from question 28 of the questionnaire (Fig. 3.24).

---

28. How well satisfied was your group with the information exchanges--  
not just content, per se-- with each other group?

- R - Rarely satisfactory
  - S - Seldom satisfactory
  - M - Moderately satisfactory
  - U - Usually satisfactory
  - C - Completely satisfactory
  - X - Varied tremendously
- 

Fig. 3.24, Question 28

One would normally expect that face-to-face and other types of direct communication are more satisfying to the individual than less direct methods. As indicated by previous discussions, the less the distance between groups, the greater the tendency for face-to-face communication to occur. One would then expect to find a similar inverse relationship between physical distance and satisfaction with communication.

As indicated in Fig. 3.23, the relationship between satisfaction and physical distance is not significant. Part of this finding may be a result of the restricted range of responses to the question regarding satisfaction. The absence of low ratings on satisfaction may be because of genuinely good communication, because of reluctance to give low ratings, or perhaps because of a bias in retrospective data collecting. It may also be that communication is perceived as satisfying as long as the technical objective of the communication is accomplished. Since these events all apparently led to successful completion of the project, communication may tend to be viewed as satisfactory.

This type of interpretation may be related to theories of cognitive dissonance. Heider's balance theory (1948) and Festinger's dissonance theory (1957) among others have noted the tendency for persons to view a given situation in as consistent a manner as possible. A feasible way to investigate the possibility that successful technical accomplishment affects the perceived satisfaction of communication would be to compare non-event RXD groups with RXD event groups. A dissonance theory interpretation would lead one to expect that groups in which successful RXD events had occurred would report a higher degree of satisfaction with communication than non-successful event groups. This predicted difference would be solely a result of the tendency for respondents to remember a given event as a wholly consistent occurrence; consistent in the sense that if the main purpose of the group was satisfied (technical achievement), other occurrences (e.g., communication satisfaction) would also be recalled in a positive manner.

--Amount of communication, type of liaison, and satisfaction--

It was felt that some relation may exist among amount of communication between groups, the type of liaison between groups and the satisfaction with communication between groups. Data from question 15 on the average amount of communication between groups was plotted in a matrix against the type of liaison arrangements which existed between the groups. There seem to be at least two types of relationships (aside from independence) which might exist between these variables. First, it may be that specialized channels develop to handle communication between groups when the average amount of communication is high and the groups are subject to information overload and confusion of various sorts. If this were the case, then one would expect to find a direct relationship between the occurrence of a liaison agent and the amount of communication.

An alternate possibility is that liaison arrangements may tend to develop when there is little contact between groups in order to facilitate whatever communications are required to provide coordination in further work on the event. This interpretation would be supported by a finding of communication inversely related to the existence of liaison agents.

Data from question 22 (Fig. 3.12) on liaison arrangements were dichotomized on the basis of whether or not some type of liaison existed. Thus responses of A, B, C and D were combined and E was a category by itself. These dichotomized data were then plotted in a matrix against the average amount of communication taken from question 15 (Fig. 3.25). Fig. 3.28 shows that there appears to be no relationship between amount of communication and the existence of a liaison agent in the data used in this study.

Fig. 3.26 represents an attempt to ascertain whether there may be a relationship between the existence of a liaison agent and satisfaction with communication between groups. As Fig. 3.28 shows, no significant relationship was found.

Liaison	37	54	23
No Liaison	24	32	25
	Low	Med.	High

Amount of Communication  
Fig. 3.25

Liaison			18	50	36	1
No Liaison	2	1	11	44	18	3
	Low					High

Satisfaction  
Fig. 3.26

Amount of Communication	High	1	8	25	22	
		1	14	40	21	2
	Low		1	7	28	7
		Low			High	

Satisfaction  
Fig. 3.27

Relationship	Chi-square Required	Chi-square Obtained	Level of Significance
Liaison versus Amount	4.6052	2.9802	NS*
Liaison versus Satisfaction	9.2363	8.5493	NS*
Amount versus Satisfaction	15.9872	16.7906	0.10

\*Tested at the 0.10 level

Fig. 3.28, Summary of Findings

In Fig. 3.27, the amount of communication was plotted against the satisfaction with communication. Although the relationship is significant at the 0.10 level, it is barely significant. Also, visual inspection shows the heavy clustering effect of the satisfaction scores due to the small ranges. However, further studies might investigate these interrelationships among amount of communication, the existence and type of liaison arrangements, and the satisfaction with communication more systematically in order to determine if relationships exist and what the nature of these relationships might be.

#### --Question 31--

The last question in the questionnaire was an open-ended question intended to elicit comments which would add to an understanding of the communication which occurred during the event, and to aid in interpreting the data obtained in the rest of the questionnaire. These comments were usually consistent with the conclusions described in previous portions of Chapter III.

One very widespread remark was that communication was free between groups and that interface contact was usually encouraged by superiors. There were no remarks indicating that it was difficult to maintain contact between groups. In some cases, the answers to this question resulted in responses to the entire questionnaire being discounted because the respondent was not actually part of the referent group at the time of the event.

Some of the more interesting responses to this question came in the form of individual philosophies and hypotheses as to why relations between certain groups were particularly good. One individual listed four reasons for good relations:

- a. an understanding of the problem and its urgency.
- b. thorough technical training and speaking the same technical language.
- c. confidence in each group's work and the belief that individuals will respect the contributions and inventions of others.
- d. group or team spirit.

These reasons are typical of those usually given and contain two which were mentioned in one form or another by several persons. The second point above, "speaking the same language," was a common point. The third point concerning the respect for and confidence in other groups was also a frequently mentioned item. That the problem of language differences at the interface is significant is indicated by item b. Mutual respect and confidence mentioned in item c. would seem to be an outgrowth of the organizational atmosphere and management practices as well as individual contributions.

### III.2 - Pilot Study

A study of the interface between research and marketing departments in industrial firms was undertaken in the Chicago area. The study was undertaken with two main objectives in mind. First, it was intended to evaluate certain interface propositions to assess their reasonableness for further, more intensive study. Secondly, it was intended to aid in the development of further studies by carefully sifting through the data for indications of both future methodological variations and future lines of investigation. The propositions investigated in the study were not intended to be specific to the marketing-research interface. Proposition 5 below is essentially equivalent to Proposition 2 investigated in the HINDSIGHT study.

#### III.2.1 - General Background

The study was carried out in three Chicago-area industrial firms. Several additional firms were interviewed and seemed to be available as potential sites, but time limitations restricted the sample size. The three firms ranged in size from a rather small engineering firm whose primary business was engineering consulting to a large, nationally known firm in the foods and industrial chemicals business. In Company 1, the engineering consulting firm of less than 100 employees, the research department was really an engineering department. In Company 2, a medium size firm, the research department also tended to perform an engineering development function. The largest company, Company 3, had a true research department in which interviews were conducted. All three companies had marketing departments which cooperated in the study.

The researchers in the study were three Northwestern University graduate students who were generally interested in interface phenomena. The instruments attempted to obtain information pertaining to six different propositions, two of which are the liaison propositions 4 and 5 described here.

#### III.2.2 - Research Questions and Propositions

The research question concerning liaison which the study attempted to in-

investigate was:

How are the existence and effectiveness of a liaison agent related to the agent's acceptance as an active group member?

The following two propositions were derived from this question:

Proposition 4: The existence of a liaison agent is not related to group acceptance of the liaison agent as an active member of the group.

Proposition 5: The perceived effectiveness of a liaison agent is directly related to his acceptance as an active member of the interfacing groups.

It was hoped that this pilot study would give indications as to whether these propositions were reasonable and worthwhile as the basis for further research.

### III.2.3 - Comments on Data Collection

Data were collected in the form of 24 completed instruments and one partially completed instrument from three Chicago area industrial firms. (See Appendix C for samples of the instruments.) Nine instruments were collected from one company (Co.1), nine instruments from a second company (Co.2) and seven instruments from the third company (Co.3). All data were collected by personal interview, the questionnaires being completed while the interviewer was present except in three cases in which the questionnaire was mailed in.

Since the instruments were administered by different persons, a constant attempt was made to administer the instruments in as consistent a manner as possible. Three interviewers were used in Co.1, two in Co.2 and Co.3. Whenever possible, interviewers sat in with each other to cross-check each other on the methods of administering and the wording of each question, and to provide subsequent feedback comments and criticism.

The instruments used for Co.2 and Co.3 were different from those used in Co.1 in that certain questions were omitted. Omitted were interview questions 5, 6, 7 and 9. Throughout the time data were collected, the Q-sort portion of the interview (questions 11 through 17) remained relatively constant although minor changes were made to enhance the interviewee's understanding of the categories as experience was gained. It is not thought that these modifications had any substantial effect on the data collected.

Modification of question 18 (Fig. 3.31) may have produced some change in responses, although we do not have sufficient data to substantiate or refute this. The question was changed to: "Which of the people on the cards you have been sorting are most effective in terms of communicating information?" This differs from the original question in that the respondent was directly asked who was most effective (not "most valuable") and the content of the information was not specified. (It was assumed that content would be job-related because almost all communication fell in this category.) Also, the respondent was specifically asked to make comments on each person named as to why he chose that person. While this modification may have changed the responses, it is felt that they were changed in a direction more relevant to the proposition than the previous form.

The data were collected on 7 days over a period of approximately one month. All the data for Co.1 were collected on two consecutive days, for Co.3 on two days of the same week, and for Co.2 on two days of the same week and one day of the next. Respondents were arranged for interviewing through our gatekeeper at each site. Thus the researchers had no direct control over who was interviewed, although in all three cases the gatekeeper understood the interests of the researchers and appeared to be interested in aiding the study. Nevertheless, the sample within each company is susceptible to criticisms of nonrandomization and selection bias on the part of the gatekeeper and availability of personnel.

#### III.2.4 - Methods of Reduction

##### III.2.4.1 - Definitions

Conceptual definitions of the variables are the same as those provided in section III.1. Operational definitions of the variables involved in propositions 4 and 5 follow:

-Group members: those persons considered to belong to a work group by at least three-fifths of the other members of the work group.

-Acceptance by group as an active member: those persons who are group members.

-Perceived effectiveness of a liaison agent: the degree to which a liaison agent is perceived by organizational members to be an effective communicator.

-The existence of a liaison agent: the existence of a person (or persons) through whom certain types of communication between work groups are channeled.

It should be noticed that in this study the liaison agent is operationally defined in terms of the structuring of the communication channels rather than solely in terms of respondent perceptions.

##### III.2.4.2 - Indicators

The methods and indicators used to evaluate the above variables are described in this section.

The primary work sheet for each company was a traditional matrix of interaction containing information regarding who each respondent contacted and who was considered part of each respondent's work group. Referring to the sample work sheet in Appendix D, reading horizontally on one row indicates who each respondent contacted. Reading vertically in a column indicates the contacts each person received.

##### --Group membership--

The primary method of identifying work group members was by response to interview question 12 (Fig. 3.29). Those persons identified as members of a respondent's immediate work group were marked on the interaction matrix. At the bottom of each column (representing one individual), totals were made of the number of persons contacting him, the number of time he was mentioned as a work group member by mar-

keting personnel, and the number of times mentioned as a work group member by research personnel. The marketing and research departments were used as feasible starting points for group composition because the sample in each company was small enough so that visual inspection could find exceptions and determine work groups fairly accurately. (A more systematic procedure would be necessary for larger samples.)

12. Ask the subject to:

PLEASE ARRANGE THE CARDS INTO THREE PILES ACCORDING TO ORGANIZATIONAL POSITION.

Put key cards on the table to indicate the categories:

- (a) work group, immediate group with whom you work
- (b) own department, but not work group
- (c) other department

Record this information on the Report Sheet.

Fig. 3.29, Question 12

It was arbitrarily decided that a person would be considered a group member if accepted by three-fifths of the work group. Therefore, those persons whose work group totals were less than two were immediately discarded. The remainder were fitted into work groups by visual inspection or were dropped later. On marginal cases, frequencies of contact, tone, content and other items were examined. The flow chart below (Fig. 3.30) shows how group membership was determined.

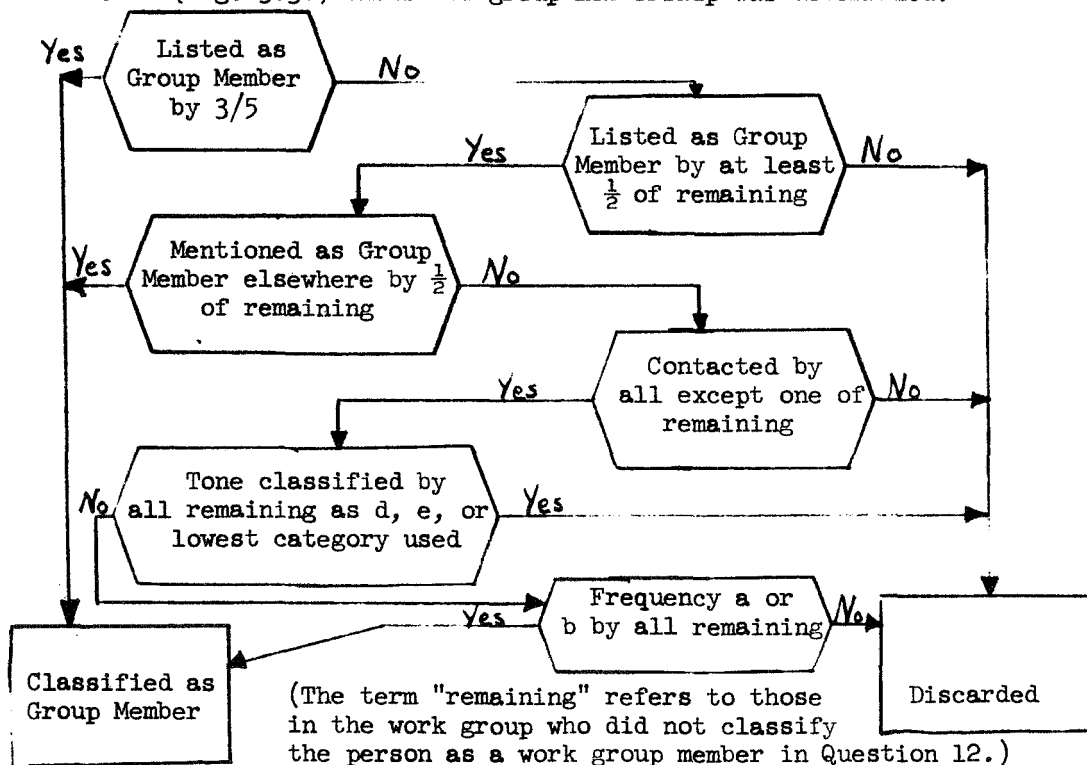


Fig. 3.30, WORK GROUP MEMBER FLOW CHART



It was found that no operational distinction could be made within our data between acceptance as an active member and group membership although the two may be conceptually different.

--Perceived effectiveness--

Perceived effectiveness was measured by question 18 (Fig. 3.31). The number of times a liaison agent was mentioned as being an effective communicator was indicated in a table (See Table 3.7). Other references in other parts of the interview were also considered in the table.

---

18. In your opinion, which of the people on the cards you have been sorting are most valuable to you as contacts and communicators of job-related or technical information?

Probe: How effective would you say these people are? Extremely effective, moderately effective, little effect...

How or why are these people valuable to you? (Get person by person comments if possible.)

---

Fig. 3.31, Question 18

--Liaison agent--

By far the most difficult variable to evaluate was the existence of a liaison agent. Since the variable was defined in terms of the structuring of information, various techniques which deal with interaction patterns were investigated. (See Festinger, 1949; Weiss and Jacobsen, 1955; Luce and Perry, 1949; and Ross and Harary, 1955.) Three main features were found to be characteristic of these techniques. First, they dealt with confirmed or reciprocated contacts. Second, in order to obtain confirmed contacts, complete (or at least extensive) interviewing of a specified group of persons was undertaken. And third, there was typically no consideration of the content of information transmitted during contacts.

Since the sample was small, involved only a small percentage of the total population, and dealt primarily with one-way or unconfirmed contacts, it was obvious that none of the standard techniques was directly applicable. In addition, it was desirable to make some consideration of the content of communication. As a compromise between what was desirable and what was possible given the limitations of the small sample, a combination procedure was devised. This involved for each company: (1) an analysis designed to specify potential liaison agents of various types based on the unconfirmed contacts; (2) an analysis as suggested by Ross and Harary (1955) on the basis of the limited number of confirmed contacts; and (3) a close analysis of the instruments themselves to determine potential liaison persons. A person was identified as a liaison agent if any two of these three criteria indicated he was a potential liaison person.

A detailed step-by-step description of the analysis using unconfirmed contacts to identify potential liaison agents is presented in Appendix D. Very briefly, the method identifies those persons who are heavily contacted within groups and those persons outside of groups who are heavily contacted by various groups. Through a series of matching procedures, certain persons are eliminated, certain persons are classified as potential liaison agents, and certain persons remain in an unsp-

ified or ambiguous position. In our terminology, a potential liaison person is one who cannot be eliminated on the basis of his communication contacts alone. In other words, those persons who are eliminated cannot be liaison agents because they do not have the required contacts within the groups being studied and they do not contact persons who do have the required contacts.

The reason ambiguous persons remain is because not all persons are interviewed. The procedure is able to classify the remaining ambiguous positions into possible types of potential liaison agents. In some cases this classification is helpful in rejecting persons as liaison agents because it would be difficult to imagine that the required communication links exist, even though they may be theoretically possible.

The most serious limitation of this method is that it is dependent on persons being interviewed being part of the same work group. That is, since the starting steps of the analysis require lists of persons whom the work group contacts, the persons interviewed must fall into one or more distinguishable work groups with each group being represented by at least three or more interviewees. If this situation does not happen to occur, the next best procedure may be to consider each department as a work group and proceed. However, using departments as work groups does not strictly fit the situation envisioned in the propositions.

A second limitation of this method is that it identifies many more persons as potential liaison agents than there probably really are since it starts with the implicit assumption that all persons who have extensive contact with any work group are potential liaison agents. Also, it may leave large numbers of ambiguous persons, depending once again on who is interviewed. It is possible to eliminate as potential liaison all those persons who communicate social information (Question 14a) but this is a weak criterion and does not often reduce the list. If more and better information were available concerning the content of communication, this method might be much more valuable; even with small samples, if the respondents are selected to represent the work groups this method may be useable.

The Ross-Harary method was tested on a reduced interaction matrix using only the confirmed contacts of the persons interviewed. Where there was disagreement as to whether contact occurred, a zero (no contact) was assumed. (No contact was assumed because if there was disagreement, it was thought to be unlikely that one of the persons was a liaison agent.) Of course, using the method this way meant that only the persons interviewed could possibly be identified as liaison persons. One limitation of the Ross-Harary method is that no attempt at all is made to consider the content of communication. A much more serious shortcoming is that liaison persons are defined solely in terms of articulation points on graphs. Thus a person cannot be a liaison agent unless his removal would result in some persons being separated from the rest of the organization (assuming a static model in which no adjustment takes place). This procedure does not allow for the identification of liaison groups or any liaison situation in which more than one person is acting as a link between two given groups.

As an example, consider the communication pattern in Fig. 3.32. It is immediately obvious that position 6 is an articulation point because its removal would result in the isolation of position 8. Thus position 6 would be classified as a liaison position by the Ross-Harary method. It is also apparent that if positions 1 and 2 were both removed, two isolated groups would remain. However, if 1 and 2 were removed individually (Fig. 3.33 and Fig. 3.34 respectively), no isolated

positions would occur. Since the Ross-Harary method considers each position individually, neither position 1 nor position 2 would qualify as liaison positions because they are not pure articulation points. It is obvious however, that both positions are important to the understanding of the network and in fact, probably intuitively qualify as liaison positions more readily than position 6. In effect, the limitation of the Ross-Harary method is its overly restrictive definition of liaison position.

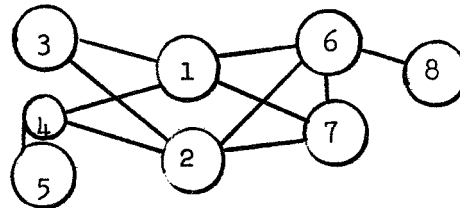


Fig. 3.32, Original Network

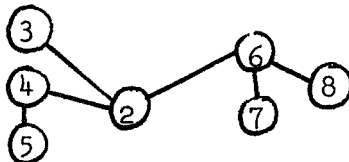


Fig. 3.33, Position 1 Removed

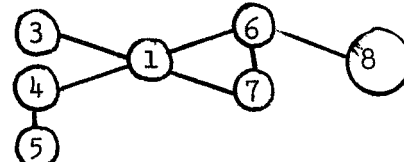


Fig. 3.34, Position 2 Removed

The third factor in identifying liaison persons involved using several other parts of the instrument. First the data retrieval forms were checked under the variable of liaison agent to locate any potential liaison agents not identified by one of the two previous steps. The Q-sort data were used in several ways to provide supplementary indications of the likelihood of each potential liaison person being a true liaison agent. Question 16 (method of contact) was not used because it was an exploratory question, and question 13 (reason for contact) was not felt to be either a reliable or valid measure of what it was intended to measure. (The question appeared to be interpreted differently by various respondents and the categories seem to need revision.)

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14. Ask the subject to:

PLEASE ARRANGE THE CARDS INTO THREE PILES ACCORDING TO THE TYPE OF COMMUNICATION OR CONTACT HE HAS WITH THESE PEOPLE.

- (a) Administrative; pertaining to salary, promotion, vacation, etc.
- (b) Technical; job-related information such as specifications, etc.
- (c) Social; matters not directly related to your job such as family, sports, etc.

---

Fig. 3.35, Question 14

A desirable feature of any attempt to identify liaison persons would be some method of determining whether persons in position 1, position 2 or both (Fig. 3.32) are liaison persons. One way of doing this is to consider the content of the communication transmitted through these positions. Since liaison persons are expected to serve a coordination function, communication which is primarily social or non-coordinative would lead one to discount a person's role as a liaison agent. An attempt was made to assess communication content in question 14 (Fig. 3.35),

but it appears that the categories provided for the Q-sort were imprecise and this question is judged to be of little analytic value. If the tone of communication were consistently low, we would also tend to discount the likelihood of a person acting in a liaison role. Results of question 17 (Fig. 3.36) vary considerably because many persons were reluctant to use the lower categories in describing their tone of communication with others. Also, it is not certain that each person considered the categories in the same way. If questions 14 and 17 can be revised to provide better answers, perhaps communication content and tone can be better utilized in identifying liaison persons.

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17. Ask the subject to:

PLEASE ARRANGE THE CARDS INTO FIVE PILES ACCORDING TO THE TONE OF THE COMMUNICATION OR CONTACT.

Put key cards on the table to indicate the categories:

- (a) Always friendly
- (b) Generally friendly
- (c) Friendly, but occasionally disagreements occur...settled easily
- (d) Argumentative, difficult to reach agreement
- (e) Mostly unfriendly

---

Fig. 3.36, Question 17

If content and/or tone did not provide a basis for deciding whether certain persons were liaison agents, frequency (question 15, Fig. 3.37) also was considered. Although it is not intuitively clear what the actual frequency of contact of a liaison agent might be (This would depend on many factors including physical distance, functional areas of each group, flow of work, etc.), it does seem likely that whatever the normal frequency of contact between groups, the liaison agent's frequency would be higher than persons who are not liaison agents (assuming the same content of communication). To illustrate how frequency can aid in identifying liaison persons, consider Figures 3.38 through 3.40. A and B represent work groups. The "+" indicates relatively high frequency of contact; the "-" relatively low frequency.

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15. Ask the subject to:

PLEASE ARRANGE THE CARDS INTO FIVE PILES ACCORDING TO THE FREQUENCY OF COMMUNICATION OR CONTACT HE HAS WITH THESE PEOPLE.

Put key cards on the table to indicate the categories:

- (a) Several times a day.
- (b) Once or twice a day.
- (c) Two or three times a week.
- (d) Two or three times a month.
- (e) Less than two or three times a month.

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Fig. 3.37, Question 15

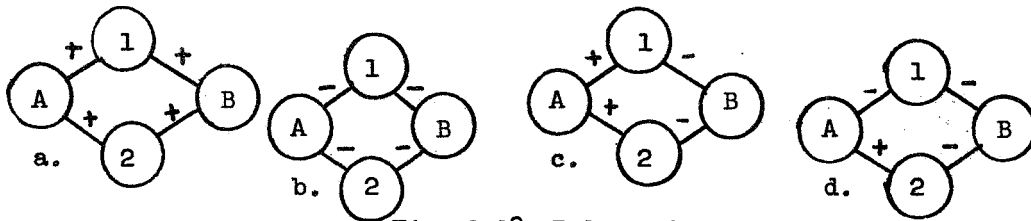


Fig. 3.38, Indeterminate

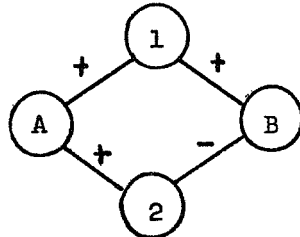


Fig. 3.39  
Possible Liaison

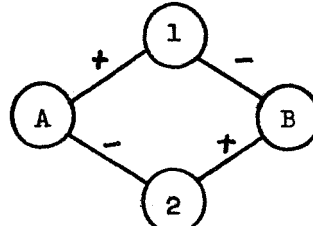


Fig. 3.40  
Possible Dual Liaison

In each case in Fig. 3.38 it is not possible to say whether a liaison agent exists without consideration of other factors, especially the content of communication. In Fig. 3.38a., it may be that 1 and 2 together act as liaison. In Fig. 3.38b., c., and d., it may be that there is simply little communication between A and B. This could be because there is no need for more communication or because there is a barrier to communication somewhere between A and B. In Fig. 3.39, frequency considerations lend weight to an interpretation of 1 as liaison agent rather than 2. In Fig. 3.40, the frequency patterns suggest that possibly 1 and 2 together act as liaison. The link between 1 and 2 should be investigated to support or refute this interpretation.

In sum, it is necessary to use as many measures as possible to identify liaison persons. If all these measures converge, even if they are weak individually, they collectively aid in determining liaison. For this reason three separate procedures were followed, each employing as many supplementary measures as possible to aid in identifying liaison persons.

### III.2.5 - Results

In general, no substantial support for the propositions was found, but neither was contradictory information evident. It is felt that more conclusive results may be obtained by increasing the sample size in each study site and by improving and refining the instrument.

#### --Company 1--

In this company, nine persons were interviewed although one interview was only half completed and parts of another had to be disregarded because of invalid responses to the Q-sort. Three work groups were identified, consisting of sales personnel, engineering management personnel, and project engineers (labeled S, R1, and R2 respectively).

Several potential liaison agents were identified, but careful reading of the instruments and knowledge of the site, in addition to the procedure specified above, led to the selection of two persons as liaison agents (1.24.R, 1.12.M). Further interviewing would assist in classification of several marginal persons. One of the liaison agents was in the sales department and one in the engineering

department. The sales liaison agent was found to be responsible for many of the duties of the Vice-President of Marketing when the latter was not in the office, a rather frequent situation. The engineering liaison agent had the title of Project Manager and was frequently mentioned by interviewees. He has recently introduced the project team system to Co.1.

The following table (Table 3.7) shows the data relevant to the propositions in this company. As can be seen, the two who are easily identified as liaison are the only two who are particularly effective. The only other person who receives more than one vote as effective is the head of personnel. He works closely with sales on the company's engineering rental service, and it is unlikely that this person serves as liaison between engineering and marketing. The Vice-President of Engineering seems to be used as a communication channel between sales and engineering only when direct contact fails to bring the desired results. The other contacts seem to be mainly generalized inter-group contacts between sales and personnel or between sales and managers of engineering. Notice that though the liaison agents are mentioned as effective more often than others, even they are mentioned only three times out of a possible eight (one incomplete interview). Also, all of the effective ratings for 1.12.M came from his own work group while 1.24.R was judged effective by at least one person from each group.

Potential Liaison Agent	Accepted as Group Member by	Chosen as Effective by				Comments
		S	R1	R2	Total	
1.11.M	S	0	0	0	0	Sales Acct. Executive
*1.12.M	S	3	0	0	3	Sales Acct. Executive
1.13.M	S	0	0	0	0	Sales Acct. Executive
1.17		0	1	0	1	Purchasing Agent
1.18.R	R1,R2	1	0	0	1	VP of Engineering
1.21.R	R1	0	0	0	0	Project Engineer
1.23.R	R1	0	0	0	0	Manager of an Engineering Dept.
*1.24.R	R1	1	1	1	3	Project Mgr.
1.25.R	R2	0	0	0	0	Mgr. of an Engineering Dept.
1.26.R	R1	0	1	0	1	Mgr. of an Engineering Dept.
1.28.R	R2	0	1	0	1	Mgr. of an Engineering Dept.
1.30	S	2	0	0	2	Head of another Dept.
1.34	S	1	0	0	1	Member of another Dept.

TABLE 3.7, Company 1 Liaison

--Company 2--

In this company, contacts between marketing and research were so diffuse that it was impossible to determine the composition of any work groups with the information available. It was likewise difficult to identify any individuals who clearly satisfied any of the criteria for classification as a liaison agent. The only possible individual who might be a liaison agent was an engineer who was responsible for scheduling projects and handling proposals in the engineering department. He was mentioned occasionally in the interviews, but it would be stretching the point to consider this person as anything but an extremely marginal liaison person. It is expected that further interviewing in this company would clarify the situation.

Three or four persons were found to stand out in the category of perceived effectiveness, each receiving several judgments as being very effective. If the propositions hold, one would expect that further data collection would show at least some of these persons to be liaison agents.

--Company 3--

In company 3 seven instruments were collected. Since this company was much larger than either of the other two, it is obvious that this number was too small to provide sufficient data for the evaluation of the propositions. Nevertheless, it seemed that some work groups started to appear. It was also possible to identify a few potential liaison agents although no individual fully qualified as a liaison person. The two work groups preliminarily identified contained one member in common who was also a potential liaison agent. Further data collection might more clearly identify both work groups and liaison agents.

Table 3.8 shows to what degree the various potential liaison agents were perceived as effective. Note that 3.3.R received the highest number of ratings as effective.

Potential Liaison Agent	Perceived as Effective by:		
	Research	Marketing	Total
3.1.R	1	0	1
3.3.R	1	2	3
3.7.R	1	0	1
3.12.M	0	0	0
3.14	0	1	1
3.22.R	0	1	1
3.40.R	1	0	1
3.53.R	0	0	0

TABLE 3.8, Company 3 Liaison

One significant difference between Co. 3 and the other companies was that interviews were conducted at a rather high level in the organization. This level was usually at a greater distance from the individual researcher and engineer than in Co. 1 and Co. 2. In the marketing department, some of the people interviewed were more accurately general managers than true marketing personnel. It is not clear that this actually made any difference in the phenomena being studied, but it is a source of possible differences. Future interviewing in this company might more profitably center on the research department per se rather than attempt to study the research-marketing interface.

III.2.6 - Discussion

As a pilot study, this work was invaluable. The study revealed certain problems in the measurement of the variables, particularly with the identification of liaison agents. To resolve this problem, multiple methods were used to try to reveal convergence. Future instruments should attempt to measure the content of communication more accurately. Measurement of perceived effectiveness may be more conveniently done in conjunction with the Q-sort as well as by direct interviewing. It is also apparent that better procedures for work group identification must be developed.

The sample size was too small in all sites for significant results, although results were fair in Co. 1 because it was a small company. The study indicated that if the sample will be small, it is important to select the sample to represent any anticipated work groups as fully as possible.

Although only in Co. 1 were liaison agents identified with any confidence and nowhere is evidence strongly in support of the propositions, there is likewise no evidence strongly contradictory to the hypotheses. Both the liaison agents received more ratings as effective than other persons in Co. 1 while both were also accepted as members of work groups. To evaluate Proposition 4, it would be necessary to identify many more liaison agents than the two which have been identified in this study.

Several observations can be made in conjunction with this study. First, communication between departments may often follow formal hierarchical channels, especially when major coordinative efforts are being exerted. This statement is supported by the comments of interviewees in all the companies, and the tendency for liaison agents (as defined in this study) to be supervisory personnel. Secondly, no adequate single method of identifying liaison persons was devised. Third, the Q-sort as used in this study was very effective in gathering large amounts of information quickly and with a minimum loss of rapport. Last, although the propositions were not clearly supported, other research along these lines seems feasible and may provide more conclusive results with the aid of sharper data collection instruments and better reduction procedures.

#### III.2.6.1 - Some Suggestions Arising From the Pilot Study

Future work in this area would include modification of several features of this study. Several possible changes of various questions have been mentioned above and in discussing the methods of reduction. In general, changes would be designed to improve determination of communication, aid in work group identification, provide more accurate measures of perceived effectiveness, and assist in identifying liaison persons. It would also be desirable to shorten the length of each interview by culling non-productive items presently included. If possible, respondents should be selected in as unbiased a manner as possible, but also in such a manner that they are representative of the various work groups.

Reduction techniques must be improved to aid in obtaining more meaningful results. Further reading and thinking should produce more feasible methods of determining work groups and identifying liaison agents. It is possible that a computer program might be used to advantage in reducing and analyzing interaction matrices.

Further studies might focus attention in slightly different areas including some additional variables. For example, it seems that some factor concerning the attitude of the management toward various communication activities might be relevant. This particular variable is mentioned several times in the interviews from all the companies. If more time were available and an extensive study were planned, the effects of different structures (project team versus functional or specialty area) on the liaison arrangements might be investigated.

#### III.3 - Discussion of the Studies

Although these two interface studies were conducted in widely different settings



and utilized different instruments and data analysis procedures, both served a valuable function as exploratory studies. The pilot study in industrial settings gave several clues to the design of better instruments in the future and pointed up the need for refinement of techniques for identifying liaison agents. For the most part, the pilot study was effective in emphasizing the need for certain methodological improvements and analytical procedures.

The HINDSIGHT study was able to generate more data directly relevant to the propositions and research questions. The value of this effort as an exploratory study is felt mainly in the verification that the phenomena of liaison and interface relations can be profitably investigated; i.e., there really is such a thing and it can be identified. The HINDSIGHT data may also be valuable as a means of studying the effects of retrospective data collection.

In general, because of the small amount of data collected in the pilot study, it was not possible to evaluate the propositions in that study in any powerful manner. However, it is interesting to note that Proposition 5 of the pilot study is virtually identical to Proposition 2 in HINDSIGHT, and that the data tend to support both of them weakly. In neither case were there highly significant effects, but there was a definite noticeable trend in the predicted direction of acceptance as a member being necessary for perception as an effective agent.

Proposition 1 of HINDSIGHT was generally supported, replicating similar findings in many other settings. It was found that the frequency of communication, the number of persons contacted, and the ratio of interactive to noninteractive communication all varied inversely with the distance (though there are some reservations with the ratio interpretation). The number of persons contacting and the total number of persons communicating were not found to be significantly related to distance. Exploratory findings found several modes of communication inversely related to distance, in this case, and the satisfaction with communication was not found to be significantly related to distance.

HINDSIGHT Proposition 3 concerning the effects of project crisis, perceived urgency, and organizational controls on the amount of communication was not verified. This seemed to be mainly because the data collected were not sufficient to carry out the appropriate analyses. In this instance, it may be that lack of complete understanding of the propositions on the part of the researchers contributed to the collection of data which were not completely relevant to the testing of the proposition. One of the interesting findings noted in the data pertaining to this proposition was that most of the crises described by respondents were matters of technical capability or problems solvable somehow by direct technical tests. There were very few remarks about crises arising from organizational structure, reorganization, or personality differences.

Additional exploratory analyses were carried out on the HINDSIGHT data. It was found that there was a slight positive relationship between the amount of communication and satisfaction with communication. No relationship was found between the existence of liaison arrangements and amount of communication or satisfaction with communication.

It was not possible to reasonably explore Proposition 5 of the pilot study because of lack of sufficient data. This proposition was concerned with group membership as related to the existence or nonexistence of liaison agents. Since

it was possible to clearly identify only two liaison agents, the data were not deemed sufficient to evaluate the proposition.

The overall assessment of these findings is that further research is necessary, and is likely to clarify much of the existing ambiguity raised by these studies. The writer is optimistic that further research can be profitably carried out and significant advances can be made in our understanding of the liaison communication process and interface relations. That it was possible to identify the relationships and trends indicated above is felt to be encouraging, especially in the light of the problems of retrospective data collection and the small amount of data in the other study. By the same token however, these problems must be considered as having possible adverse effects of the relationships and causing them to appear significant when they are actually spurious. As is the usual case, for most behavioral science research, further research is necessary.

## CHAPTER IV: METHODOLOGICAL PROBLEMS AND RESEARCH DESIGNS

This chapter briefly discusses some of the methodological problems encountered in the two empirical studies before dealing with more general problems to be faced in studies of liaison activities. After a discussion of these general problems, a possible research design is outlined and discussed with regard to specific propositions.

### IV.1 - Some Methodological Problems

#### IV.1.1 - Selection Differences

The pilot study of local industrial firms differs substantially from the HINDSIGHT study in the way the study sites were selected. The basic criteria for a study site in the pilot study was that the firm accept the researchers and allow them entry. Whenever this is the case, that the sites are selected on some basis other than their theoretical appropriateness for the substantive area being investigated, selection biases are a threat to the validity of any findings which may result from the study. The plausible rival hypothesis is that the firms which allow outside persons to enter and study internal phenomena are in some way significantly different from those who refuse entry. Although it was possible for the researchers to be slightly selective in the pilot study because there were more available sites than could be handled, selection biases are still a threat.

In the HINDSIGHT study, it was possible to select sites somewhat more on the basis of their theoretical relevance than in the pilot study. This would tend to reduce the possibility of selection bias. However, the data used for analysis in this paper were contributed by only two of the sites. Since there is a possibility that these two installations differ in significant ways from the other sites, a slightly different type of selection threat is present in the HINDSIGHT study. Generally, however, one would expect that the pilot study would be more susceptible to selection biases because of greater freedom to reject researchers than appeared to exist in HINDSIGHT sites.

#### IV.1.2 - Location of Researchers

The HINDSIGHT study was markedly different from the pilot study in that the researchers were employees of the installation in which the data were collected. There seem to be several advantages and disadvantages which may be identified with in-house personnel doing research. One of the main advantages is that reactivity of in-house research is likely to be quite less than when an outsider enters the organization to collect data. In certain cases the in-house researcher may be able to collect data in a truly unobtrusive manner. By being on the scene constantly, he is able to absorb many of the everyday occurrences and the organizational atmosphere which are difficult for the outsider to assess. In this case, since much of the data were retrospective, this advantage may have been largely nullified. Still, reactive effects due to interviewing would seem to be less with in-house personnel.

A disadvantage of in-house researchers may be that they are often less objective than more detached persons from outside the organization. It would

appear to be quite difficult for in-house personnel to take at face value the comments of personal acquaintances when these researchers may know respondents quite well on a personal basis. This can be both an advantage and a disadvantage depending on the substantive area. In most cases, however, objectivity is desirable and the in-house researcher is at a disadvantage.

In the pilot study described in Chapter III, the researchers were also the persons who had developed the instruments and the research propositions. Thus they were closely acquainted with the purposes of the study and with the details of the instruments. They were able to be considerably flexible in their wording of interviews because they had a rather precise idea of the type of information which was desired. Too much of a vested interest in the study might on the other hand affect the behavior of outside researchers with respect to possible "leading" of interview subjects and "over-interpretation" of data. In HINDSIGHT the researchers had only a rather superficial knowledge of the exact purposes of the study. Conversations with one of the researchers indicated a certain amount of confusion as to exactly what certain parts of the questionnaire and the interview were "getting at." It seems likely that it was this incomplete understanding of the propositions and the instruments which led to some of the obtained data being unsuitable for use in analyzing the propositions.

Whether researchers should be located within the organization or outside of it in a given study can be seen to be a tradeoff involving among other things the factors of researcher objectivity, reactivity of experimental arrangements, and the required knowledge of propositions and instruments. In the HINDSIGHT study it was necessary to collect a large amount of data over a fairly long time period involving numerous data forms and several propositions. The use of in-house personnel was desirable from the standpoint of the many forms and the long time period, but disadvantageous from the standpoint of knowledge of propositions and bases for the study. The short time period and restricted range of the pilot study tended to make use of outside researchers more feasible, but at the expense of increased reactivity.

#### IV.1.3 - Retrospective Data

The major way in which HINDSIGHT differed from the pilot study was in the nature of the data collected. Some of the kinds of problems associated with data collected in retrospect have already been noted (III.1.3). Although it was not possible to accurately assess the exact effect of forgetting on the data, two questions in the questionnaire were designed to allow some estimate of the severity of forgetting. In question 30 (Fig. 4.1) the respondents were asked to make an estimate as to how well the questionnaire represented the actual situation.

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30. To what extent does this questionnaire now represent the true situation?

\_\_\_\_\_ Grossly oversimplified  
\_\_\_\_\_ So-so  
\_\_\_\_\_ Presents a good picture

---

Fig. 4.1, Question 30

Of thirty-six responses to this question, two persons felt the true situation was "grossly oversimplified" by the questionnaire, ten felt that the questionnaire "presented a good picture," and twenty-four indicated that the questionnaire was only "so-so." It would seem that these responses serve as a warning to the researcher to be cautious about interpreting the data.

Question 31 of the questionnaire was an open-ended question in which the respondent was asked to describe more fully any important aspects of the communication interchange which had not been tapped by the questionnaire. This question served as a sort of "free-for-all" in which respondents often presented their own personal philosophies. In some cases remarks in answer to this question contributed to discarding the entire questionnaire. For example, in one instance the respondent completed most of the questionnaire and then remarked in the last question that he had not been at the laboratory at the time of the event, but had completed the questionnaire on the basis of what he thought would have occurred, knowing the people involved. While his responses may have been accurate, this type of second-hand information attenuated by ten to twelve years of forgetting was deemed insufficient and was discarded.

Since data were collected in the pilot study in reference to the current situation, there were no problems of retrospective data. It was found, however, that the addition of a "free-for-all" period at the end of the normal interview period often generated significant information which could be used in evaluating the previous contents of the interview, and which often added additional information of its own. Respondents generally had some bits of philosophy which they were happy to expound upon when given the opportunity.

As a methodological device, the unstructured question at the end of an instrument seems to be valuable in maintaining rapport, and in aiding the proper interpretation of the instrument. In addition, this type of question also often contributes information valuable in its own right.

#### IV.1.4 - Single Indicators

Both of these studies were primarily exploratory studies. Since this was the case, there was not a great deal of consideration given to multiple methods of confirming the indicators of variables. For example, in the HINDSIGHT study it has already been noted that there was essentially only one way to identify liaison agents: by perceptions of the respondents. In the pilot study, even though individual indicators of liaison were rather weak, collectively they were much stronger in identifying liaison persons. It would have been desirable if this procedure could have been followed for all the variables being investigated. In the HINDSIGHT study, it was virtually impossible to evaluate the proposition concerned with project crisis because of very little confirmed information on the existence or nonexistence of crises. In addition, the information which was available was solely in the form of respondent perceptions. If some more objective measure of crisis were available, it may have been possible to verify certain statements about the occurrence of crisis and to test the proposition more thoroughly.

In measuring phenomena in organizations, it seems desirable to use indicators from different "viewpoints" whenever possible. At least four such viewpoints appear to be available. One would like to observe the phenomenon him-

self if this is feasible. Also, it is usually desirable to obtain information from the persons who are actually involved in the phenomenon. The viewpoint of a third person in the organization would often prove to be valuable. And finally, unobtrusive techniques which may provide objective clues to many phenomena are often quite useful.

Data obtained by direct observation may often be fairly objective, but they are subject to reactive effects of the participants. Unobtrusive techniques tend to avoid reactivity, but it is not always possible to uncover or develop suitable indicators for the phenomenon being investigated. Data from participants are usually collected in liaison and interface studies and appear to be invaluable in most cases. This source is always subject to subjective biases on the part of the respondents. Third persons in the organization may provide insights, but they too must be considered to have personal motivations and goals which may bias the data. However, when several of these methods are used and they tend to converge, one can usually have high confidence in the nature of the variable being measured.

#### IV.2 - Some Problems of Research Design in the Study of Interface Phenomena

The second section of this chapter discusses at some length certain problems of research design and the ways in which they are relevant to research concerned with interface and liaison phenomena. Some limitations of the more common types of designs are discussed, and the advantages and disadvantages of several experimental designs are considered. Real-time studies are discussed in prelude to the third section of the chapter which outlines a possible real-time experimental design. The entire discussion draws heavily on the terminology and graphical conventions of Campbell and Stanley (1966). To assist the reader who is not familiar with that work, brief definitions of major terms are given below:<sup>6</sup>

Threats to internal validity:<sup>7</sup>

- History: the specific events occurring between the first and second measurement in addition to the experimental variable.
- Maturation: processes within the respondents operating as a function of the passage of time per se (not specific to the particular events)...
- Testing: the effects of taking a test upon the scores of a second testing.
- Instrumentation: ...changes in the calibration of a measuring instrument or changes in the observers or scorers used which may produce changes in the obtained measurements.

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<sup>6</sup>Quoted directly from Campbell and Stanley, 1966, p.5 and 6.

<sup>7</sup>Threats to internal validity are those circumstances which might cause a spurious relationship to be interpreted as a true relationship. External validity refers to the extent to which any relationships discovered in the experimental study may be generalized to non-experimental situations. It is apparent that internal validity must always take precedence over external validity wherever one is forced to choose between the two.

- Statistical regression: operating where groups have been selected on the basis of their extreme scores.
- Biases resulting in differential selection of respondents for the comparison groups.
- Experimental mortality, or differential loss of respondents from the comparison groups.
- Selection-maturation interaction, etc., which in certain of the multiple-group quasi-experimental designs,...might be mistaken for, the effect of the experimental variable.
- The reactive or interaction effect of testing, in which a pretest might increase or decrease the respondent's sensitivity or responsiveness to the experimental variable...

Threats to external validity:

- The interaction effects of selection biases and the experimental variable.
- Reactive effects of experimental arrangements, which would preclude generalizations about the effect of the experimental variable upon persons being exposed to it in non-experimental settings.
- Multiple-treatment interference, likely to occur whenever multiple treatments are applied to the same respondents, because the effects of prior treatments are not usually erasable...

#### IV.2.1 - Classes of Designs

This section does not attempt to consider and evaluate all of the many possible designs which might be used in investigating liaison relationships. Instead, consideration will be limited to studies which investigate some hypothesized relationship. This limitation includes two main categories of studies. First, a study may have the purpose of describing an hypothesized relationship, usually with the implied assumption of causality. The second category includes those studies intended to test a predicted causal relationship. The categories are similar in that both types of studies derive from a theoretical base which usually provides a model of some sort, operationally and conceptually defined variables, and some propositions. Excluded from consideration are studies which are purely exploratory in nature and descriptive studies which do not have specific initial hypotheses.

Generally an experiment or quasi-experiment is necessary to legitimately test for causation, although most descriptive studies of the type outlined above imply a causal sequence in the propositions. Discussions of various types of studies will follow the framework of threats to internal and external validity as presented in Campbell and Stanley (1966). Naming and diagramming of experimental designs are taken directly from that volume. Descriptive studies will usually be assumed to be ascribing causation to the relationships

being investigated, although these studies may not spell out the causal sequence to the extent that true- or quasi-experiments do.

In the first category discussed above, two common types of studies may be identified: the pure descriptive study and pre-experimental studies. Pure descriptive studies are those in which there are no control or comparison groups. All the observed groups are measured or tested on the same dimensions and the results are reported as representative of the entire sample, not as a comparison between the sample and the control group. Pre-experimental studies are those in which some control group is used, whether it is part of the original tested sample or another sample.

#### IV.2.2 - The Case Study and the Survey

Both pre-experimental and purely descriptive designs are usually variations of the case study or the survey design. In this paper, a case study is defined as a study in which a series of observations are made over time in a single experimental unit. A survey is a study in which one observation is made in each of several experimental units. The two designs are related as shown in Fig. 4.2 below. It is obvious from the diagram that the two designs

Experimental units Tests or Observations	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	A <sub>4</sub>	A <sub>5</sub>	A <sub>6</sub>	...
O <sub>1</sub>				X			
O <sub>2</sub>				X			
O <sub>3</sub>	X	X	X	X	X	X	
O <sub>4</sub>				X			
.							
.							
.							

← Survey

↑ Case Study

Fig. 4.2

converge as the case study is performed in an increasing number of experimental units and/or as the survey is performed at several different times in the same set of units.

The survey design is often associated with questionnaires or telephone polls involving large numbers of experimental units (e.g., persons or organizations), but this design includes all studies in which a single instrument package is ad-



ministered once to each experimental unit. Even if the package is administered to several subunits (persons) within a unit (organization), if each unit is examined only once and the results are reported as representing the unit, the study is still considered a survey.

In a case study, the observation period is generally much longer than in a survey, often being weeks or even months. Rather than being a single observation however, the case study is usually composed of many observations of the same phenomena or persons. The essential difference between the two is the number of observations and measurements of each unit. The main similarity is that both the case study and the survey are attempts to describe actual relationships to see if they agree with the hypothesized relationships.

The survey and the case study may be evaluated in terms of threats to internal and external validity, even though these are not true experiments. This exercise may be helpful since so much research in the area of interface and liaison relations tends to be in one of these two forms.

The possibility that the unique history of the site may provide a reasonable explanation of the observed relationships is an important threat to the internal validity of case studies. This threat is virtually unavoidable in the pure case study, but becomes less severe as the number of sites is increased. Since the survey technique is constrained to one measurement in time, and because it involves several sites, history is not relevant as a threat to the validity of survey studies.

Although maturation generally refers to the biological and physical changes that occur over time, it may occasionally be relevant in the study of groups and organizations. Especially when the study may involve growth processes of groups and/or organizations, maturation may pose a plausible rival explanation of the phenomena in case studies. This variable would not seem to be a relevant threat in surveys for reasons similar to those given for history.

Testing as a threat to validity refers to the effects of taking a pretest on scores of subsequent tests. ("Testing" as used here can refer to true tests, interviews, Q-sorts, questionnaires, observation or other techniques.) Since neither the survey nor the case study is a true experiment involving pretests and posttests per se, this threat is not directly applicable. However, it is possible that wording of interviews, questionnaires, or mere observational procedures may lead the respondents or participants in the study to act in ways not normal and to give atypical responses which may lead to incorrect conclusions on the part of the researcher. This reactive effect of testing is a threat to both internal and external validity. Not only may testing result in inadvertent learning or adjustment of behavior which may change the relationship being studied, but the results obtained on any reactive measure may not be generalizable to populations which have not been exposed to the reactive measure. This effect is a common criticism of many pure case studies, and it is a particularly difficult one to control without designing true experiments. If the observer is able to make some estimate of the effect of his presence or of other reactive arrangements, it may be easier to judge what the actual relationship being observed would be if such reactive measures were not employed. Just what this effect is, is certainly not an easy thing to estimate.

(See R.K. Bain, 1960, for an example of the difficulties and dangers in attempting to estimate the reactivity of the researcher's role.)

The more unstructured the measurement techniques are in both the case study and the survey, the greater is the possibility of instrumentation becoming a threat to internal validity. Especially in the case study, where techniques are likely to be quite unstructured, the opportunity for measurement techniques to change over the course of the study provides a definite plausible alternative explanation of many observed results. The danger is not usually as great with surveys because they typically employ more rigid measurements such as questionnaires, Q-sorts, and so forth. When interviews are used as primary survey techniques, the danger of "putting words into the mouth" of the respondent is present, especially if the researcher believes he perceives a pattern of responses which he may then tend to elicit through his expectations.

Statistical regression effects are not usually a relevant threat in surveys because these types of studies are not concerned with measurements over time, but rather with measurements at a given point in time. Case studies, on the other hand, may in some instances be subject to regression effects depending on how the site being investigated was chosen. If the site was chosen on the basis of extremeness on some measure not totally independent of the relationship being studied, the possibility exists of the experimental unit regressing toward the mean of the measure on which the site was selected.

This does not seem to be a very strong threat in the case of liaison studies because the basis for selection of sites usually seems to be relatively independent of the relationship being studied. Even when there is not complete independence, if the unit being studied is on the order of an organization, the case study will often take much less time than it would take for the site to regress a significant amount toward the mean. If the unit being studied is a group which was selected for its extremeness, regression effects must be considered. If, for example, a group was selected for study because its members obtained the lowest scores on a vocabulary test, at a later date the group members would be expected to have regressed toward the mean and obtain higher scores on the same test. It might then be erroneously concluded (if regression were not considered) that some particular type of communication pattern (whatever one happened to be observed) is related to increasing vocabulary. The direction of regression should always be ascertained to check whether it would work in the same or opposite direction of the observed or predicted relationship. In most cases, this would probably not be a very strong rival hypothesis.

Selection and mortality are not plausible threats to internal validity when discussing case studies and surveys because control groups are not involved.

The case study and survey are quite vulnerable to various threats to external validity. One of the most plausible alternate explanations is that the observed relationship is specific to the particular sites or site used in the study. Both in the case study and the survey, the organizations which agree to allow research to be done within them, may be qualitatively different from those which refuse such requests. This threat of selection bias cannot be

alleviated without a control group. However, even with a control group the threat still exists to some extent because even control groups may differ from other organizations.

The danger of reactive effects of testing and of study design have already been mentioned and briefly discussed. These limitations are virtually insurmountable in case studies, but are also threats in many surveys. A related threat is also a danger in case studies, where several different types of measures or tests might be employed. Where the effects of prior tests, observations, interviews or other measures are likely to affect future behavior on other unrelated measures, the explanation of multiple-treatment interference may be a rival hypothesis with some validity. This is not a likely threat to survey studies.

#### IV.2.3 - Pre-experimental Designs

When survey studies segregate respondents into two or more groups, it is often possible to introduce the semblance of a control group into the design. Although the resulting design is not a particularly strong one, it controls for several threats to internal validity which the pure survey does not. This design is essentially what Campbell and Stanley (1966) call the static group comparison design and it is discussed thoroughly in that volume. An example of this type of design might be the classification of organizations in a survey into two groups on the basis of whether they have a functional or project-type R and D organization. Further data would be collected within this framework and compared on this basis. In general, the kind of relationship which this design is used to investigate is usually of the form: If X exists (or the more of X), then Y exists ( or the more of Y) with some probability, p.

The static group design, through the addition of a comparison group (not a true control group), controls adequately for the rival hypothesis of history (Fig. 4.3). Testing and instrumentation are also eliminated as strong plausible explanations. Maturation is not normally an important explanation for most of the relationships studied in liaison and interface studies, although there is not really enough know about the phenomenon to eliminate it completely as a possible explanation. In this design, differential selection biases may be a limitation to the internal validity of the study although selection interaction threats seem to be more serious limitations. Interactions of selection and other variables permit the possibility that the differences on which one segregates the respondents into two (or more) groups may be related to other factors which comprise a reasonable alternate explanation of the observed relationships.



Static Group Comparison  
Fig. 4.3<sup>8</sup>

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8

The presentation of designs uses the same terminology as Campbell and Stanley (1966). An X refers to an experimental treatment; O indicates testing or observation; R means random assignment to experimental and control groups; a dashed line indicates the comparison groups are not equated by randomization. The temporal order is from left to right.

Differential mortality may be a threat to internal validity in some cases, but this does not seem to be a very strong alternate explanation.

Regression effects are not normally a threat in this design because measurements take place at a point in time, not over time. When the survey is expanded to include measurements at different times, one has essentially a multi-group comparison design in which regression effects must be considered. (This same situation can also be reached by increasing the number of sites in which identical case studies are undertaken.) Regression may not always present a plausible explanation, but the direction of the regression effects should be considered.

The static group comparison design is subject to the same restrictions on external validity as the pure survey design. The multi-group design is also subject to the same restrictions on external validity, especially with regard to the possibilities of multiple treatment interference.

#### IV.2.4 - True and Quasi-experiments

In the true- or quasi-experiments, the aim is to investigate a relationship by testing a predicted causal hypothesis. At the present time there does not seem to be a great deal of this type of work being done. By far the greatest effort of the empirical work in the area of liaison and interface tends to be with designs which are modifications of the pure case study or the pure survey or the pre-experimental designs. These sort of descriptive studies are important in helping to establish a base upon which to build further theory and research, but it seems that experiments provide a much better opportunity to test models in the field. Not only do experimental studies offer the advantage of better understanding, but they also are excellent ways to make knowledge directly useful to the practitioner. Conducting experiments in ongoing situations seems to be a valuable way of applying and testing knowledge or organizational design. If experiments do show differential performance between units, it is to the researcher's advantage in terms of knowledge and respondent rapport, and to the respondent's advantage in terms of identifying worthwhile (or at least better or worse) techniques for his use.

It is, of course, impossible to discuss all experimental designs in this paper and that is not intended. There is a large literature on this subject for reference and more detailed discussion. (See Fisher, 1935, for a classic work.) In this paper, the discussion will center on a few experiments which seem particularly appropriate to the study of liaison because of the characteristics of the phenomena and of the sites typically used for these studies.

##### IV.2.4.1 - Threats to Validity in Liaison Studies

###### --Internal validity--

Because of the nature of liaison phenomena, certain threats to validity are more serious than others, and must therefore be given greater consideration when considering various research designs. Two particularly serious threats to most liaison studies are testing and instrumentation changes. In almost all studies, testing is reactive to some degree because the settings in which the research takes place are not frequently tested populations. Instrumentation becomes a greater threat the more unstructured the techniques are, the more novice the researcher is,

and the more the researcher is aware of the predicted results.

History is a plausible rival hypothesis primarily when single units are studied, although it may also be an explanation in some other designs. Selection biases are possible threats in liaison studies whenever there is a danger that the units being studied are different even before the experimental treatment has been administered.

Maturation explanations are usually not particularly relevant to liaison phenomena since they entail biological and physiological changes. Mortality is also generally a weak threat to internal validity. Regression artifacts are not normally plausible explanations of changes in liaison experiments because experimental groups would not typically be selected because of extreme scores. Selection is usually on the basis of access rather than test scores. Selection interactions may be threats to internal validity in some cases, selection-testing interactions being perhaps the most dangerous.

In general, the most serious internal threats to validity to liaison studies would be testing, instrumentation, selection, and history. This would behoove the researcher to choose those designs which minimize these threats.

#### --External validity--

Studies of liaison phenomena are susceptible to three main types of threats to external validity, each of which is a serious limitation. Interactions of testing and the experimental treatment causing the treatment to have effects which would not have occurred without the pretests are the first of these. Selection interactions with the experimental treatment are a second major source of limitations on the generality of many liaison studies. This threat becomes more severe the greater the difficulty in obtaining experimental sites. The general reactive arrangements of most liaison studies are difficult to avoid and comprise the third set of threats to external validity which the researcher must consider when selecting research designs.

#### IV.2.4.2 - Distinction Between Group and Organizational Designs

Studies of liaison and interface activities generally involve comparisons at the organizational and/or group level. Researchers are usually interested in the interactions between groups or organizations when studying liaison, not in the interactions between individuals per se. Even when the subject under study is the characteristics of liaison agents, these persons cannot be studied without first identifying the interfacing entities and then identifying who is acting as liaison. It is obvious that one cannot enter an organization and study liaison agents without first locating interfaces and interfacing entities, whether they be groups, departments or organizations. (When reference is made to groups, let us understand that primary groups such as work groups, are intended. Liaison studies may be concerned with primary groups or with collections of groups such as departments, organizations, divisions, and so forth which we shall call organizations in the remainder of this section.)

Since the phenomena of liaison and interface must be studied at either the group or organization level, it follows that randomization can occur only at the group or organization level. This normally implies that one has a much smaller population to draw from than one has in studies which can focus on the

individual without regard to the group he belongs to. Although it is sometimes possible to randomize at the group level, it is usually extremely difficult to obtain sufficient numbers to do so at the organizational level. Also, the study of liaison and interface relations is normally conducted in existing situations rather than laboratory or simulated settings. Therefore, it is often difficult, if not impossible to employ true randomization in experimental designs for studying liaison. The problems of gaining access often legislate toward small sample sizes, especially when dealing with collections of groups rather than primary groups.

Although randomization is often difficult in liaison studies, it is frequently possible to vary the timing of the experimental treatment so as to control for certain threats to validity. It is also possible to vary the recipients of the experimental treatment to some degree. However, both these procedures - the timing of and the recipients of the treatment - may be subject to constraints imposed on the researcher when gaining access.

#### IV.2.4.3 - Organizational Designs

##### --Time series designs--

As was mentioned above, when one is experimenting at the organizational level, sample sizes are often too small to allow for adequate randomization. In cases such as these, the most feasible designs are usually the quasi-experimental time series designs. These designs are essentially extensions of case study designs employing an experimental treatment. In cases where the existing organizational records can be used as adequate measures by the researcher, these designs may be especially useful. The basic time series designs are shown below:

O O O OXO O O O

Single Time Series

Fig. 4.4

$\frac{O}{O} \frac{O}{O} \frac{O}{O} \frac{OXO}{OO} \frac{O}{O} \frac{O}{O} \frac{O}{O}$

Multiple Time Series

Fig. 4.5

The multiple time series design is preferred over the single time series in all cases where it is possible to obtain a comparable second site for the experiment. The addition of a control group eliminates history as a possible explanation of any observed change after the experimental treatment. A control group also weakens the alternative explanation of changes in instrumentation as the reason for observed changes. In a single time series study, history and instrumentation are always difficult to rule out as possible main effects which might account for an observed difference in the experimental unit.

In both time series designs, records of personnel changes must be kept to check for the possibility that experimental mortality might provide a plausible explanation. If the experimental treatment coincides with certain persons leaving their positions (or being hired), it might be impossible to determine whether the treatment or the personnel change was responsible for an observed difference. This threat would not be a problem if measures were being made of individuals rather organizational units of some size (Campbell and Stanley, 1966, p. 41).

While both these designs are strong in internal validity (the multiple time series controlling for virtually all internal threats), they are quite weak in external validity. An important uncontrolled factor is the general reactivity of experiments in organizational settings. The danger is that the experimental arrangements and procedures may change behavior in such a way that the situation and the experimental effects are unrepresentative of the population to which one wishes to generalize. Closely related to reactivity is the possible interaction of testing effects and the experimental treatment. This threat refers to the possibility that pretesting may cause certain changes within the tested unit such that the experimental treatment will have different effects (which show up on the posttest) than if pretesting did not occur. (Testing may refer to true testing, interviews, self-initiated reports, or even more observation and casual remarks concerning the subject which the researcher is investigating.) Since one is usually dealing with populations which are not subject to frequent testing, testing interaction effects and reactivity are very definite threats to the external validity of these designs.

In cases in which existing institutional records may serve as data for the experiment, the time series designs are particularly useful. Whatever measures are used, it is important that consistent measures be used throughout the experiment. It may often be desirable to keep parallel sets of measures (i.e., both institutional records and the researcher's records) which can act as checks on each other if the institutional data can be related to researcher data in some way. It is not always possible, of course, that relevant organizational data is kept or that it is accessible. For example, if one is investigating the effectiveness of project teams as evidenced in the meeting of time schedules, the data may be much easier to obtain than if one is trying to measure the effectiveness of interpersonal communication.

In general, the following limitations to time series designs may be identified:

1. Since it is necessary to make several observations both before and after the experimental treatment, these designs may often involve considerable lengths of time. This is especially true if the hypothesized changes are expected to take a relatively long time to be observable.

2. The designs are weak in external validity. They present especially severe problems in regard to reactivity and the interaction effects of testing in settings in which testing is atypical.

3. It may often be difficult to find organizations which meet the desired characteristics of the researcher and which are willing to allow the researcher to actively experiment. This adds to the problem of selection biases. Associated with this limitation is the difficulty that organizations may often be reluctant to allow a control group to continue in its control status if the experimental treatment has produced what appears to be significant positive results.<sup>9</sup>

Some strong points of these designs are the following:

1. In many cases, it may be possible to utilize existing organizational

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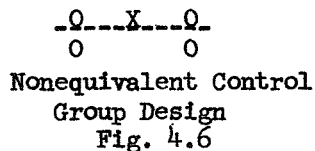
<sup>9</sup>Suggested in seminar with Prof. A.H. Rubenstein, May, 1967.

records to advantage, either to supplement or to replace researcher measures. If these can be used in place of researcher measures, reactivity and testing effects may be greatly reduced.

2. In general, the internal validity of the multiple time series is very good.

--The nonequivalent control group design--

A modification of the multiple time series design which does not require as much time or as many observations is the nonequivalent control group design (Fig. 4.6). It is essentially the multiple time series design with a single observation before and after the experimental treatment. This design is no worse



in external validity and often nearly as strong in internal validity as the multiple time series. Although regression effects and selection interaction effects are uncontrolled, these do not seem to be particularly strong threats to internal validity in many potential studies of liaison and interface. The longer period of observation in the time series designs allows for a more complete basis of comparison of post-treatment to pre-treatment conditions. This factor would appear to be important especially when the treatment is expected to result in gradual rather than sharp or immediate changes in the existing situation.

In both the time series and the nonequivalent control group designs, the organizations being studied are assumed to be selected so as to be comparable in the subject area being studied. It seems that the less comparable they are, the most desirable it is to use the time series design versus the nonequivalent group design. By using more measures over a longer time period, differences which may exist between the organizations would tend to show up and could be recognized in the interpretation of results. In considering differences between government and industrial settings, it may be that greater uniformity of government laboratories makes the nonequivalent design more feasible there than in industrial laboratories.

#### IV.2.4.4 - Group Designs

Discussed in this section are designs appropriate for studies centered on groups, in which there is likely to be a chance for some semblance of randomization because of the greater number of experimental units. These designs are also theoretically possible at the organizational level, but it seems quite unlikely that sufficient organizations will normally be available to achieve randomization. In the following discussion it will be assumed that sufficient numbers are available to meaningfully randomize, and that the study consists of one experimental treatment. (i.e., We do not consider designs which employ several treatments, such as counterbalanced designs of various sorts.)

Designs which require several groups may draw their sample from several different organizations or from entirely within one large organization. If all



groups are within the same organization, there is a much greater potential for reactive effects than if the groups are from several organizations. Especially when experimental and control groups are likely to be in contact and have opportunity to discuss the experiment, reactivity can be a serious threat to both the internal and external validity of the experiment. On the other hand, drawing groups from many different organizations adds considerably to the time, expense and inconvenience to researchers of the experiment, and in the extreme case (when only one group is used in each organization) presents the same sampling problems as one would face if studying organizational interfaces. Obviously some compromise must be made between the ideal of perfect isolation of experimental and control groups and the worst situation in which the experimental and control groups are intimately related.

In discussing designs appropriate for group studies, preference will be shown to those which minimize the number of observations, other things being equal. This preference is based on three reasons. First, minimizing the number of observations will tend to minimize the reactive effects of the design. Secondly, it is generally felt that each observation or test "costs" the researcher something in terms of rapport. Thirdly, minimizing observations will aid in minimizing experimental costs and time.

--The posttest-only control group design--

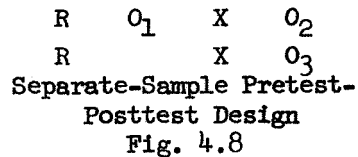
The posttest-only control group design (Fig. 4.7) is a true experimental design which is feasible for the investigation of group liaison and interface activities. This design is very strong internally, provided that true randomization of groups is possible. The main threats to external validity are reactivity of experimental arrangements and selection interactions. The possibility that organizations which allow experiments to be conducted are qualitatively different from others (i.e., selection interactions) is a difficult threat to

R      X   0  
R        0  
Posttest-Only Control  
Group Design  
Fig. 4.7

disregard. Similarly, reactive effects of the experiment are a definite possibility. Overall, however, this design is a relatively strong one which requires a minimum of observation. Since no pretest is used, the effects of testing are well controlled for. This design would seem to be a very good one when true randomization is possible.

--The separate-sample pretest-posttest design--

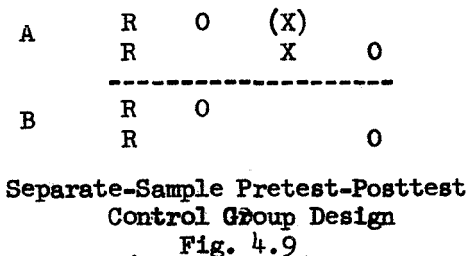
An alternative design to the posttest-only is the separate-sample pretest-posttest design (Fig. 4.8). While this design is weaker internally, it is quite strong in terms of external validity. The tradeoff between this design and the previous design may be evaluated in terms of the importance of internal versus external validity in a given case. The separate-sample design allows as possible explanations of observed changes the main affects of history, maturation, and various selection interactions although these are not typically strong rival hypotheses in liaison studies (See section IV.2.4.1). Instrumentation may also reduce internal validity if precautions are not taken to minimize these effects. The primary threat to external validity is once again interactions of selection



and the experimental treatment. Testing interactions and reactive arrangements are controlled in this design.

--The separate-sample pretest-posttest control group design--

If it happens that history and/or maturation might provide plausible rival hypotheses, it may be desirable to use the separate-sample pretest-posttest control group design (Fig. 4.9) rather than the previous design. Since this design requires more groups and is generally more expensive and time consuming, it would not normally be employed unless it is absolutely necessary to control for history and maturation and to maintain a high level of external validity. This design is superior to the posttest-only design in that it has good external validity.



If it is possible to randomize between section A and section B (Fig. 4.9), it is possible to control for selection-testing (and other) interactions, but since this would increase the time and expense even more, this procedure would not normally be followed unless selection-testing interactions provided particularly important plausible rival hypotheses.

#### IV.2.5 - Real-time Studies

In the discussion of experimental designs, it has been more or less implicitly assumed that these studies would be carried out on a real-time basis. That is, the experiment would be observed and measured while it was occurring, not in some retrospective manner. Since the term "real-time" is borrowed from other fields and because its meaning for the social sciences is not necessarily the same as its meaning in other fields, a brief discussion of the term is in order.

##### IV.2.5.1 - The Meaning of Real-time

The phrase of "real-time" is used by those concerned with computer systems to indicate a system in which the results of the computer operation are available in time to be immediately useful to the physical operation. The important variable in this definition is the timing of feedback for the purposes of control. The difficulties of applying this definition directly to other non-computer systems are discussed by R.V. Head (1964).

In the social sciences, real-time studies are normally equated with those in which the data are collected at the time and place of the actual occurrence. The

important variable in this view is the timing and location of the data collection process in relation to the process being studied. Although the usual real-time study does employ "on-the-spot" types of data collection procedures, it seems that two more fundamental criteria may be identified.<sup>10</sup> First, real-time data is collected for the purpose which the researcher has in mind. This does not mean that the researcher himself must collect the data, but that whoever collects the data must be collecting it for the same purpose as is the researcher. Thus records kept by an organization which coincide with the data which a researcher needs and wants may often meet this qualification.

The second criterion is that the data must retain the time sequence of the actual occurrence and identify the occurrence uniquely in the real world. Simply stated this means that the data must accurately represent what really happened and when it happened. It is this qualification which normally causes one to equate real-time data with that collected at the time of the occurrence by the researcher. Since it usually becomes more difficult to recall the actual occurrence accurately with the passage of time, one normally thinks of real-time data as collected at the time of the happening. Since it is usually felt that the researcher is more objective than the participants, one often associates research-collected data with real-time data. (Of course, there are certain types of data which are very difficult for the researcher to obtain, such as physiological and psychological responses. It is often necessary to rely on participant reports for these data.) Remembering these two criteria, further discussion will consider real-time as (1) accurately representing what actually occurred, and as (2) having been collected for the specific purpose which the researcher had in mind.

It appears that regardless of the definition one uses, real-time cannot be distinguished from non-real-time studies on a dichotomous basis. It is much easier to say which one of any two studies is "more" real-time than it is to specify an abstract measure for classifying into one category or the other. In general, real-time studies attempt to overcome inaccuracies in data which may occur in non-real-time studies because of (1) forgetting, (2) subjective changes over time (autistic bias), or (3) attempting to use irrelevant data by drawing inferences which may be quite unjustified. To the extent that these factors can be avoided in the collection of data, one may consider a study to be real-time.

#### IV.2.5.2 - Limitations of Real-time Studies

Generally, one prefers real-time studies to non-real-time studies because the feeling is that the data are more accurate and therefore more reliable in using to evaluate the hypothesis. An important practical limitation in obtaining real-time data is that the researcher cannot usually be present all the time to collect data. This means either that the data must be collected by some sampling procedure, or that some arrangement must be made for participants to collect data. Both sampling and self-reporting have certain disadvantages which must be weighed against each other in the particular situation to determine the more feasible solution. Normally some kind of mixed strategy is followed.

Sampling procedures must attempt to minimize reactive effects of the re-

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<sup>10</sup>The following two criteria were pointed out to be by C.W.N Thompson.

researcher's presence while also minimizing the time between the occurrence of an event and the collection of data relevant to the event. The inherent conflict between these objectives is discussed in relation to a decision-making study by A. H. Rubenstein (1966). Although the factors he discusses are applicable to other studies besides decision studies, it seems that liaison studies may be slightly more amenable to sampling procedures than some other types. Because many of the topics being investigated in liaison and interface experiments are continuing processes, the danger of missing particular "events" is not as great as it seems to be in studies of decision-making and information requirements. "Events" in many liaison studies are probably less important to the researcher than the pattern of normal communication and related acts. This seems to make sampling a feasible procedure in such studies.

In liaison studies, self-reporting techniques may not be as useful as they are in certain other substantive areas. Self-reporting techniques are generally highly reactive in liaison and interface studies because they call direct attention to phenomena which might not normally be consciously recognized by the participants. Whether behavior is changed and in what way it is changed is a virtually unanswerable question. In general, it would seem desirable to use sampling techniques as much as possible and to minimize self-reporting arrangements. A mixed strategy which employs sampling with a self-reporting technique for unusual or critical incidents might be desirable.

The use of a participant observer may be a particularly useful and desirable strategy in studies of liaison and interface. This solution would appear to maximize the exposure to the phenomena being studied while minimizing reactive effects. The advantages and disadvantages of using participant observers have been discussed in other places and should be considered. (See for example Holmberg, 1960 and Becker and Geer, 1960)

#### IV.2.6 - Other Considerations

The researcher is not usually free to evaluate research designs solely on the basis of their internal and external validity. Certain other factors, such as practical considerations, the specific settings in which the researcher will occur, and the hypotheses to be investigated must also enter into the design decision. The table following attempts to summarize the relative standing of the designs which have been discussed on several practical factors as well as on validity. It should be remembered that this is a rough summation of many factors and does not necessarily represent all individual cases. The table (Table 4.1) was prepared assuming that a given hypothesis was being investigated.

In the table, the factor of time is based on the number of observations of a given group or organization which are required. As such, it also indicates to some extent the degree of cooperation required of the units in which the experiment is taking place. Sampling requirements are derived from the number of experimental units the design calls for. Access refers to the difficulty which might be encountered in arranging for the experimental units to participate. As used in the table, it is a function of the number of sites required and the degree of cooperation required. This factor would probably rarely be low when conducting true or quasi-experiments since finding an organization which will allow experiments (rather than mere testing and observation) to be conducted may always be difficult. However, if the experimental procedure involves a minimum of disruption of normal activity, the non-equivalent design and the posttest-only de-

sign may be relatively low on this factor. Cost is assumed to be related to the length of the study and the difficulty of the sampling procedure. Other cost items, including analysis expense, instrument design expense and so forth are not considered here because they do not differentiate between designs. The columns referring to internal and external validity are crude attempts to summarize the discussions of the individual designs. In any specific situation, each design should be evaluated in relation to the relevant hypothesis to determine the possible threats to validity.

Type of Design	Time	Sampling Require- ments	Diffi- culty of Access	Cost	Threats to Internal Validity	External Validity
Case Study	M	L	L	L	H	H
Survey	L	L	L	M	H	H
Static and Multiple Group Comparisons	M	L	L	M	H	H
Single and Multiple Time Series	H	L	M	M	L	H
Nonequivalent Control Group	M	L	L-M	L	L	H
Posttest-Only Control Group	L	M-H	L-M	L	L	M
Separate-Sample Pretest-Posttest	M	M	M	M	H	L
Separate-Sample Pretest- Posttest Control Group	M	H	H	H	L	L

H-High; M-Medium; L-Low. The entries are in relation to the other designs and do not represent absolute amounts. In all cases, L indicates a more desirable situation than M or H.

TABLE 4.1  
Various Design Characteristics

Although tables of this type must be interpreted carefully, Table 4.1 is helpful in presenting some various tradeoffs which must be considered in deciding on various designs for research. The table shows a general trend for the

designs with the greatest overall validity to also have the greatest practical limitations and vice versa.

The researcher normally considers the various designs in light of the particular propositions he has in mind. As mentioned earlier, the time series and non-equivalent designs are especially appropriate for hypotheses concerned with organizations or large departments as a whole because they require only a small sample (one or two as a minimum). In general, the researcher should examine his propositions to determine which threats to validity would be particularly dangerous and choose designs accordingly. Since testing and reactive effects are such a potentially strong threat in many liaison and interface studies, all the above designs have been chosen as possibilities because they attempt to control for these factors.

#### IV.2.7 - Summary

This section has attempted to discuss in general terms some of the factors which must be considered when evaluating various research designs for studies of liaison and interface activities. No attempt has been made to specify any "best" design since this will vary depending on many factors relevant to the particular situation. Important points which this section has discussed include the following.

1. The selection of a research design usually includes considerations of
  - a. the internal and external validity of the design.
  - b. the characteristics of the research setting which may affect the design.
  - c. the rival hypotheses to which the specific propositions are particularly vulnerable.
  - d. the practical limitations of the design such as time, cost, difficulty of gaining access and sampling problems.

2. Most studies of liaison and interface have tended to be descriptive studies employing relatively primitive survey, case study or pre-experimental designs which have many shortcomings in terms of both internal and external validity.

3. Real-time experimental studies, while requiring more work on the part of the researcher, provide correspondingly more information about one's model. In addition, experiments may offer the opportunity to demonstrate to the practitioner the relevance and worth of studies of liaison phenomena as well as aiding him in a practical sense.

4. In studies of liaison, the most serious threats to internal validity usually take the form of explanations invoking history, testing, instrumentation or selection biases. Interactions of testing and the experimental treatment, selection and the experimental treatment, and reactive arrangements all are serious threats to external validity frequently encountered.

#### IV.3 - A Possible Research Design

The purpose of this section is to propose a possible research design for further study of liaison activities at research interfaces. There is no attempt to develop propositions, but it is necessary to assume certain general types of research questions in order to discuss parts of the design. There is

also no attempt to develop specific instruments, but certain types of data collection techniques and possibilities are discussed.

#### IV.3.1 - The Research Area

The paper thus far has assumed that the existence of a liaison agent is a "good" thing, that it facilitates coordination among groups in a way that is better than if such a communication channel did not exist. The experiment described here will attempt to determine whether the existence of a liaison agent makes any difference in group performance in certain situations. The situations which will be investigated will be various stages during the life of a project as it is handled by a given research group.

The following two research questions are assumed:

1. Does the existence of a liaison agent make a difference in terms of the effectiveness of groups working on a particular project?
2. Does the effectiveness of a liaison agent vary over the stages of a project (aside from the personal characteristics of the agent)?

One of the things one would like to know about liaison activities is the nature of situations in which liaison agents are effective and in which they are not effective. The two questions posed above are aimed at investigating the hypothesis that the stage of the research project is one of the variables which affects the effectiveness of liaison agents. If project stage is a major variable, one would expect to find consistent differences in effectiveness at different stages. Lack of differences may indicate that there are other more powerful variables which influence effectiveness, or that project stage is an irrelevant consideration in effectiveness of a liaison agent.

The second research question uses the term "effectiveness of a liaison agent." It is intended by this phrase to imply that the liaison agent is effective in terms of the effectiveness of the interfacing groups (as in the first research question) in accomplishing certain objectives. It is also desirable to consider the effectiveness of the agent as it is viewed by the groups, but this is not intended to be the prime consideration.

#### IV.3.2 - Experimental Design

The phenomena referred to by the research questions requires that the experimental design be one of the group designs discussed in section IV.2.4.4. Since the questions refer to a population of groups, ideal sites would be those in which there are large numbers of groups at work on fairly diverse projects. The more diverse the projects are, the less one would expect contamination of control groups by experimental groups and vice versa. If large installations are accessible, the experiment could be carried out in a relatively small number of sites, possibly less than half a dozen. Government laboratories would appear to be ideal.

##### IV.3.2.1 - A Potential Design

The separate-sample pretest-posttest design (Fig. 4.10) appears to be a feasible design to use in the investigation of these research questions. The

R	O <sub>1</sub>	X	O <sub>2</sub>
R		X	O <sub>3</sub>

Separate-Sample Pretest-Posttest Design  
Fig. 4.10

primary requirement of this design is that there be sufficient groups to allow randomization of the experimental treatment. Assuming that it is possible to attain this criterion, this design would be desirable.

The normal procedure for using this design would entail randomly assigning the experimental units to two groups. The first group would be pretested, subjected to the experimental treatment, and then posttested. The second group would not be pretested, but would receive both the experimental treatment and the posttest. This procedure allows the researcher to estimate the effects of testing as well as the experimental treatment. By measuring the discrepancy between O<sub>2</sub> and O<sub>3</sub>, testing effects can be estimated. The difference between O<sub>1</sub> and O<sub>2</sub> gauges the effect of the experimental treatment and is a check on the O<sub>1</sub>-O<sub>3</sub> difference.

One major threat to the internal validity of studies employing this design is the possibility that instrumentation changes may mask a true effect, or falsely simulate a true effect. This would be especially true if inexperienced researchers were utilized as they may be expected to vary their behavior and data collection procedures as the experiment progressed. Generally, however, this threat can be minimized through careful attention to systematic and consistent data collection techniques.

Other possible uncontrolled threats to internal validity in this study are the main effects of history and maturation. Neither of these appears to pose a strong rival hypothesis in this case. The interaction of selection with history or maturation is likewise a weak rival hypothesis. For example, it would be necessary for such an alternate explanation to hypothesize that the groups selected for the experimental treatment underwent a maturation or historical process different from that undergone by the other groups and that the interaction then caused the observed effect. This does not seem to be a likely hypothesis.

With regard to external validity, this design is quite strong. By observing the second group only after the experimental treatment has been administered, any observed experimental effect cannot reasonably be said to have been specific to previously tested populations. The same procedure controls for reactive effects as long as there is no contamination of experimental and control groups. If the study is to continue over a fairly long period of time, it may be quite difficult to prevent this type of contamination and it may become a threat to internal as well as external validity. It appears that the only thing the experimenter can do to minimize this contamination is to keep the study as short as is feasible and to select groups which will have as little chance as possible to interact. By choosing groups on this latter basis however, care must be taken not to subject the design to criticisms of selection bias.

The primary threat to external validity is the possibility that the sites in which the experiment is conducted are different from the population to which one wishes to generalize. This is usually a rather strong criticism of many studies



in organizations. It is normally plausible to claim that the organizations which allow outsiders to enter and conduct a study are different from those which refuse outsiders. This claim becomes even more serious when the researcher not only wishes to study, but actively manipulates variables within the organization. In other words, the subset of organizations which allows outsiders to experiment within its boundaries is smaller than the subset which allows studies to be conducted, and is very much smaller than the set of organizations to which the researcher wants to generalize. There seems to be little that the researcher can do to refute this statement besides attempting to get as representative a sample as possible, and by pointing out the similarities between the sites being studied and the population at large.

#### IV.3.2.2 - Experimental Procedure

For purposes of discussion, assume that six government sites are available and that permission has been received to experiment with twelve work groups in each site. The groups are to be selected by the researchers, subject to approval by management at each site. The researcher would then proceed to select twelve groups at each site which would be in contact with the other selected groups in each site as little as possible. Across sites, the groups would be as similar as possible. In other words, Group 1 at Site 1 would be similar to at least one group at each of the rest of the sites. Once the work groups had been selected and approved, they would be randomly assigned to two sections without regard to institutional location. Section A would be observed (or tested) at Time<sub>1</sub>. (Time<sub>1</sub> would probably be some period of time rather than a single point in time.) Both Section A and Section B would receive the experimental treatment at Time<sub>2</sub>, and both would be observed (or tested) at Time<sub>3</sub>.

In this design the experimental treatment would be the assignment of some person to serve as a liaison agent. The design as discussed above would test the effects of the assignment of a liaison agent provided the required indicators of effectiveness existed. However, it is desirable to test also the effectiveness of the liaison agent in different stages of the project life. For this added complexity it is necessary to modify the design somewhat.

Taking Section A and Section B, the thirty-six work groups in each section would be randomly assigned to three sub-sections. These sub-sections would be used to allow the assignment of the experimental treatment to vary over the stage of the project life. Fig. 4.11 indicates in summary form the design as discussed to this point.

As mentioned in the figure, the time periods used in the figure may not all be of equal length. This is because the sub-sections are randomly selected before the experiment starts, and it may be necessary to wait for varying amounts of time for each group to reach the proper stage in the life of a project before the experimental treatment is begun. Thus the pretest period (T<sub>1</sub>) may vary somewhat for individual groups depending on what part of the project the group is working on when the experiment begins and what particular sub-section the group is assigned to.

A slightly different procedure may be used to minimize the variability of the first two time periods. If it is possible to assume that the groups in the two sections will be randomly distributed throughout various stages of the pro-

	Time Period*	Section A			Section B		
		Sub-Section A1	Sub-Section A2	Sub-Section A3	Sub-Section B1	Sub-Section B2	Sub-Section B3
Pretest	T <sub>1</sub>	Yes	Yes	Yes	No	No	No
Treatment Assigned at:	T <sub>2</sub>	Beginning of Project	Middle of Project	End of Project	Beginning of Project	Middle of Project	End of Project
Posttest	T <sub>3</sub>	Yes	Yes	Yes	Yes	Yes	Yes

\*The time periods as indicated here may not be of equal length.

Fig. 4.11 Potential Research Design

ject they are working on at the time the experiment begins, then assignment to the various sub-sections can be deferred until the pretest period is complete. This allows for a uniform length of the pretest period. The groups will be assigned to sub-sections at the end of the pretest period on the basis of the stage in the project at that time. There will still be some variability because it is unlikely that exactly one-third of each section will be at different stages in a project at the time the pretest period ends. Nevertheless, this procedure will tend to minimize the variability and should be no threat to the validity of the study as long as the assumption of random distribution of the groups across stages of the project at the beginning of the study is valid. There seems to be no reason why this assumption would not be true.

In some studies utilizing this design, it may be possible to discontinue the experimental treatment and make another series of observations after the discontinuance to see if a change results. In other studies of which this particular one is typical, the experimental treatment is likely to cause changes which are not readily reversible. Thus it is not feasible to add this extra phase to the design.

#### IV.3.2.3 - Real-time Data Collection

A significant feature of this kind of experimental study is the collection of data at the time and place of the occurrence of the phenomena. Some of the problems and characteristics of real-time data collection are discussed more fully in section IV.2.5.

In this study two considerations are of major importance when considering arrangements for real-time data collection. First, because the study would be expected to cover a fairly long period of time, it would probably become necessary to either use sampling techniques to obtain data, or to arrange for the data to be collected by in-house personnel. Secondly, because the topic of the study would probably be highly sensitive to any outside interference, it is necessary to introduce the experimental treatment as unobtrusively as possible. To be consistent with this, measurement procedures would have to be kept as nonreactive as possible to avoid changing the phenomena being studied.

In line with suggestions made earlier (IV.1.4), it would be desirable to

use several different sources of information throughout the study. Since the study would be fairly lengthy (It would be ideal if the pretest and posttest observation periods would cover at least one full project life.), in-house personnel could be used efficiently to make periodic reports and to keep running records of much of what is going on in the organization. It would be necessary, of course, to regularly survey these reports to make certain the desired information was being collected. This source would appear to be relatively non-reactive and could provide valuable data.

Supplementing special in-house efforts would be organizational records of various sorts. These data would be especially important in assessing the effectiveness of work groups in terms of meeting schedules, staying within budgets, and developing technical competence as evidenced by publications. (See Lipetz, 1965 for an extended discussion of the problems of measuring efficiency of research, and the need for better measures. Wank, 1958, in one of the few empirical studies of liaison relationships, discussed measures of effectiveness and some shortcomings of certain measures.) It would be wise to survey as many of the organizational records as possible to foresee possible ways of using them to aid in monitoring the progress of the study. These data have the advantage of being unobtrusive and nonreactive. Many times however, they may not be directly relevant to the researcher's purpose, and they may often be collected and generated in such a way that they do not represent what they are purported to represent.

While it is usually desirable to obtain data from the participants in the experiment itself, one might not attempt to do so in this experiment until after the experimental treatment had been completed. Because knowledge that a work group was being used in an experiment would likely pose a serious threat to the internal validity of the study, every possible means would have to be made to keep knowledge of the exact purpose of the study from affecting the behavior of the participants. By interviewing or testing the participants after the experiment rather than during it, a substantial degree of reactivity may be avoided. In this case, the data obtained would be retrospective to a certain degree rather than being truly real-time.

Another view of participant information might be to routinize the testing of the respondent in such a way that the measures attain a certain status of nonreactivity by the time the experimental treatment is administered. This might be accomplished through a self-reporting technique of some kind in which the participants (or perhaps selected participants) would be asked to report unusual incidents at the time they occur, or at regular intervals. If this procedure were initiated at the time of the start of the pretest, participants may become used to the routine by the time the experimental treatment started. This reporting technique would have to be practiced by members of both Section A and Section B.

A primary purpose of real-time studies is to assure the researcher of valid and reliable data. This normally implies that the researcher himself will collect the data, and such a procedure would be an important part of this experiment. As mentioned previously, the probable length of this study appears to necessitate the use of a sampling technique to complement other techniques. If there is a sufficient number of work groups (as there would be in the study as described here), it would be feasible to design a random schedule of observations for the researcher. Also, since the researcher is interested in everyday, routine

occurrences as well as unusual incidents, a random schedule would be no worse than a more systematic schedule in allowing the researcher to witness important incidents. If it were necessary to observe critical incidents and it was not especially desirable to record routine phenomena, a different type of schedule might be desirable.

A completely random schedule might randomize on the time at which an observation would take place, the group to be observed and the length of the observation. However, the design of any sampling schedule would have to take into consideration such factors as the time and funds available to the researcher. For example, if the sites are located physically distant from each other, it may be desirable to use a systematic rather than a random procedure for determining in which site certain observations may occur. Nevertheless, from a theoretical point of view, random observations would not appear to be detrimental to the data collected in studies of liaison because all observations are important whether or not unusual incidents occur. Since communication is likely to occur almost constantly, most observations will yield some data of value.

Summarizing, it would seem that a potentially useable pattern of collection techniques could consist of the following mix:

1. The use of organizational records and other unobtrusive techniques, especially to assess the effectiveness of various research groups in organizational terms.
2. The use of in-house personnel to keep regular records to supplement organizational records. This would include reports of crises, outstanding accomplishments and other unusual occurrences as well as more routine records.
3. The use of self-reporting devices to assess the impact of liaison arrangements on the members of work groups. This technique could possibly be supplemented by interviews and/or questionnaires after the experimental treatment.
4. The use of a sampling schedule (probably random) for the researcher to observe different groups at different times for varying periods of time. This schedule would be subject to constraints of researcher time and funds as well as location of the sites.

#### IV.3.2.4 - Some Important Aspects of the Analysis

This type of design allows many opportunities for comparisons of different measures taken at different times.

1. Measurements taken at Time<sub>1</sub> compared to measurements at Time<sub>3</sub> would be expected to show the main effects of the experimental treatment. Since there are six sub-sections, there are numerous comparisons which can be made between Time<sub>1</sub> and Time<sub>3</sub>. In general, it is correct to say that the difference between A<sub>1</sub>/T<sub>1</sub><sup>11</sup> and A<sub>1</sub>/T<sub>3</sub> should be the same as the difference between A<sub>1</sub>/T<sub>1</sub> and B<sub>1</sub>/T<sub>3</sub>. If this is not the case, one might suspect that some testing effect occurred and caused the discrepancy. This discrepancy is a rough estimate of the effects

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<sup>11</sup>Read "sub-section A<sub>1</sub> measured at Time period 1."

of pretesting on a posttest.

2. All measurements at  $T_1$  should be equal. This should be true because of the effects of randomization in equating the groups. If it is not true within reasonable limits of error, it may be difficult to assess the comparative differences of liaison agents at the different stages of the project life.

3. If there is an effect of the experimental treatment, the difference between  $A_1/T_1$  and  $A_1/T_3$  (or  $B_1/T_3$ ) should be greater than the difference between  $A_{i+1}/T_3$  (or  $B_{i+1}/T_3$ ). This statement merely says that there should be a greater difference shown by the groups in which the liaison agent was initiated at the start of the project than in the other groups if the existence of a liaison agent has a continuing effect on the effectiveness of the groups. If the liaison agent does not have a cumulative-type effect, the differences described here would not exist, or they would be small or perhaps unrelated. Thus the design is not fully able to describe how the effects of the liaison agent vary across the stages of the project, but careful analysis of the data may give valuable clues upon which further studies may be based.

These three points are important parts of the analysis which are made feasible by this particular design. Although the design does not provide as comprehensive information about how the effects of the liaison agent vary over project life as might be desirable, it does provide some data relevant to this question. With regard to whether a liaison agent actually has an effect, this design appears to be fairly powerful.

## CHAPTER V - CONCLUDING REMARKS

### V.1 - Summary of Propositions

In Chapter II and Chapter III of this thesis, several propositions were presented and discussed. It is appropriate at this point to summarize them and review their interrelationships with each other. Table 5.1 lists the propositions and indicates the chapter in which they first appeared as well as the portion of the thesis they refer to.

Chapter	Proposition	Refers To
II	I: To be perceived as effective by group members, informal liaison agents must be perceived as protecting the interests of and representing the referent group. It is not necessary for formal liaison agents to be perceived as representing group interests for that group to perceive such agents as effective.	Model
II	II: The existence of informal liaison agents is more likely to produce dysfunctional consequences in functionally-oriented laboratories than in project-oriented laboratories.	Model
II	III: The permanence of the interfacing groups is directly related to the effectiveness of the informal liaison arrangements.	Model
II	III: The establishment of formal liaison roles will increase the effectiveness of communication transfer between interfacing groups which have a relatively short life span.	Model
II	IV: At transition interfaces, liaison agents perform mainly a function of boundary definition; at coordinative interfaces, mainly an integration function. The translation function is performed at both types of interfaces with equal likelihood.	Model
II	V: Other things being equal, liaison agents are more likely to be found where the perceived freedom to communicate horizontally between groups and other organizational units is low (i.e., where there are perceived management barriers to communication) than where perceived freedom to communicate is high.	Model
II	Va: Given that a liaison role exists, liaison agent effectiveness tends to be higher with a low degree of freedom to communicate than with a high degree of freedom to communicate.	Model
III.	1: As physical and geographic barriers increase, other things being equal: a. the frequency of (interface) communication decreases. b. the number of people engaging in interface communication decreases. c. the ratio of interactive to non-interactive (interface) communication decreases.	HINDSIGHT

TABLE 5.1 - Summary of Propositions  
(continued on next page)

# Chapter Proposition

Refers to

- III 2: Perception (by the group members) of a liaison agent as an active member of a work group is a necessary condition for perception of him (by the group members) as an effective liaison agent for that group. HINDSIGHT
- III 3: Given the situation of project crisis, changes in (the amount of) interface communications will be positively related to:
  - a. changes in perceived urgency
  - b. changes in instability of organizational controls
- III 4: The existence of a liaison agent is not related to group acceptance of the liaison agent as an active member of the group. Pilot Study
- III 5: The perceived effectiveness of a liaison agent is directly related to his acceptance as an active member of the interfacing groups. Pilot Study

TABLE 5.1 - Summary of Propositions (cont.)

The HINDSIGHT and pilot study propositions preceded in time the development of the model. This can be seen in the propositions. Propositions 2 and 5 for example, are nearly identical, both investigating the relationships of work group membership and perceived effectiveness of a liaison agent. Proposition I is concerned with the same phenomenon but presents a somewhat more specific and differentiated manner of looking at the problem. Similarly, Proposition VI is a more refined statement of HINDSIGHT Proposition 3.

Propositions II, III and V attempt to recognize other variables which may affect the performance of a liaison agent which were not included in the HINDSIGHT and pilot studies. These propositions consider respectively, the structure of the laboratory and organization, the permanence of interfacing groups, and the perceived freedom to communicate.

Proposition IV makes a statement about the nature of the function the liaison agent performs. Most of the rest of the propositions dealt with the effectiveness of liaison agents since this was the emphasis of the empirical studies. This proposition is directed more toward research on the actual activities which the liaison agent performs. Future work must be concerned with both these areas.

## V.2 - Summary of Findings

In Table 5.2 below the findings from the empirical study are listed. More complete discussion of these findings may be found in Chapter III, but these results are presented here in summary form for convenience.

PROPOSITION	FINDING
Prop. 1	Physical distance was found to be inversely related to the number of persons contacted in other groups, to the maximum frequency of communication between groups, and to the ratio of interactive to non-

PROPOSITION	FINDING
Prop. 1 (cont.)	<p>interactive communication. The ratio interpretation is made cautiously because of clustering of responses.</p> <p>Physical distance was not found to be significantly related to the number of persons from one's own group contacting others or to the total number of persons communicating between groups.</p>
Prop. 2	Acceptance of a liaison agent as a group member was not found to be significantly related to perception of the agent as an effective communicator, although the relationship was nearly significant. It is possible that this relationship is a spiral relationship.
Prop. 3	The data was insufficient to properly test the relationship between the amount of interface communication and perceived urgency or instability of organizational controls. In addition, it was not possible to identify any typical pattern of communication over the life of a project.
Supplementary Analyses	<p>Distance was found to be inversely related to frequency of contact through intermediaries, by face-to-face, transfer of documents, by telephone, and by conferences. It was found not to be related to satisfaction with communication.</p> <p>No relationship was found between the existence of a liaison agent and the amount of communication or between the existence of a liaison agent and the satisfaction with communication. There was a barely significant relationship between amount of communication and satisfaction in the direction of higher satisfaction with more communication.</p> <p>It was found that most crisis described were of a technical nature rather than concerned with organizational or personality problems.</p>
Prop. 4	It was not possible to properly evaluate this proposition because of lack of appropriate data.
Prop. 5	The data neither supported not contradicted the proposition that perceived effectiveness of a liaison agent is related to acceptance as a group member.
Supplementary Findings	<p>It appeared that interface communication may often follow formal heirarchical patterns when major coordinative efforts are involved.</p> <p>No adequate single method of identifying liaison agents was uncovered.</p> <p>The Q-sort as modified in the pilot study was very useful as a means of collecting large amounts of data quickly and with a minimum loss of rapport.</p>

TABLE 5.2 - Summary of Findings



### V.3 - Conclusion

This paper has attempted to investigate and discuss three aspects of liaison phenomena at research interfaces. First, a basic model of interface processes was developed and discussed. Boundaries of organizational entities were seen to be fundamental to the development of this model. Further discussion pointed out the importance of organizational structure in influencing the underlying framework leading to interface activities. The organizational atmosphere as evidenced in the various controls exercised by management and in the perceived attitudes of management was presented as having an important effect on the kind of communication patterns used by members of work groups. Personal characteristics of liaison persons were not discussed at length, but it was recognized that there may be significant differences in persons who effectively fulfill liaison roles from those who do not occupy such roles.

In summarizing the model, three "levels" of variables may be identified. It was felt that the basic or lowest level was concerned with the variables relating to organizational structure. These variables set the framework within which all interface activities must take place. The next higher level of variables was associated with the normal work flow required by the technology of the organization. Normally this set of variables would tend to override the structural level of variables, and one would expect relationships to occur among groups required to work together by the flow of work. The third set of variables are those connected with situations of unusual urgency or crisis in which normal procedures are overridden to allow for extreme procedures to achieve the immediate goal. At all three levels, the effects of interpersonal relationships and work group relationships are felt in modifying the normal communication channels and content.

The second major section of the paper discussed two empirical studies. Both of these studies were essentially exploratory studies, although they were both ostensibly seeking to evaluate certain propositions.

The HINDSIGHT study was characterized by its dependence on retrospective data. Some problems presented by this kind of data were discussed. Three propositions were evaluated. It was found that there was a tendency (not significant) for liaison agents perceived as effective to also be perceived as group members. This tendency was also observed in the pilot study, but it was not quite as obvious, possibly because of the smaller sample size. An inverse relationship was found between physical distance and several aspects of communication transfer. This relationship was not found to hold for satisfaction with communication. It was not possible to determine if a relationship existed between changes in communication and changes in the urgency or crisis situation of a project.

In a supplementary analysis, the data were examined to see if any relationship might exist between the existence or nonexistence of a liaison agent and frequency or satisfaction of communication. No relationship was evident. An interesting observation that may be made on the basis of HINDSIGHT data is that most of the crises that were described by group members were caused by technical problems rather than by organizational changes or personality problems.

The third section of the paper has dealt with some of the factors of research design which must be considered in studies of liaison and interface activi-

ties. Some of the prominent methodological problems of the two empirical studies were briefly discussed.

In a final portion of this section, an outline for a real-time experiment suitable for further research on the liaison phenomenon was presented. It is appropriate that the assumed topic of this experiment was concerned with whether or not the existence of a liaison agent made any difference in the performance of work groups. The development of theory and research on liaison activities is at such a stage that even this question has not been thoroughly investigated.

This thesis represents an effort to develop a basic interface model which can be used to guide the emphasis of future empirical studies of liaison phenomena. The exploratory studies described in Chapter III have contributed significantly to the development of this model. It is hoped that studies of the type described by the potential research design can be carried out in the future as it appears that field experiments, in the long run, are one of the most effective and efficient methods of adding to our knowledge of these areas.

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## APPENDIX A

### Condensed Organization Charts

Site A\*  
Site B\*

### Sample Printouts

Program PRECMPR\*  
Program INTERFAC  
Data Card Listing\*

\* Omitted on distribution copies to maintain confidentiality.

NUMBER OF RESPONDENTS= 16  
NUMBER OF RESPONSES = 59

>16	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
10	0	0	0	0	0	1	0
8	1	1	5	0	0	0	0
6	0	7	1	0	0	1	0
4	3	5	7	1	2	1	0
2	3	5	5	3	3	1	0
NR	2	0	1	0	0	0	0
A B C D E F V							
NO. COMMUNICATING VS. DISTANCE							

A	3	3	4	0	0	0	0
B	2	3	8	0	0	0	0
C	0	4	3	2	1	0	0
D	2	4	4	1	2	2	0
E	0	4	0	1	2	2	0
F	0	0	0	0	0	0	0
NR	2	0	0	0	0	0	0
A B C D E F V							
FACE-TO-FACE VS. DISTANCE							

A	4	5	4	0	0	0	0
B	1	3	8	2	1	0	0
C	0	3	4	1	1	2	0
D	2	4	3	1	2	1	0
E	0	3	0	0	1	1	0
F	0	0	0	0	0	0	0
NR	2	0	0	0	0	0	0
A B C D E F V							
MAX. FREQUENCY VS. DISTANCE							

INTERFAC Printout  
(Cont.)



>8	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
5	0	0	2	0	0	0	0
4	1	1	2	0	0	0	0
3	1	3	5	0	0	1	0
2	4	9	8	4	1	2	0
1	2	5	2	0	4	1	0
NR	1	0	0	0	0	0	0
	A	B	C	D	E	F	V
NO. CONTACTING VS. DISTANCE							

>8	0	0	0	0	0	1	0
8	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
5	0	2	1	0	0	0	0
4	1	4	2	0	1	0	0
3	0	5	8	0	0	1	0
2	3	5	2	1	2	1	0
1	3	2	5	3	2	1	0
NR	2	0	1	0	0	0	0
	A	B	C	D	E	F	V
NO. CONTACTED VS. DISTANCE							

A	0	0	0	0	0	0	0
B	1	1	1	0	0	0	0
C	3	4	11	1	0	1	0
D	2	5	1	0	1	1	0
E	1	6	3	0	4	2	0
F	0	2	3	3	0	0	0
NR	2	0	0	0	0	0	0
	A	B	C	D	E	F	V
CONFERENCES VS. DISTANCE							

A	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0
D	2	2	7	1	0	0	0
E	1	1	2	0	3	1	0
F	4	15	10	3	2	3	0
NR	2	0	0	0	0	0	0
	A	B	C	D	E	F	V
INTERMEDIARY VS. DISTANCE							

A	1	5	3	0	0	0	0
B	1	3	9	2	1	0	0
C	1	1	4	0	1	2	0
D	3	2	3	1	1	1	0
E	1	5	0	1	2	1	0
F	0	2	0	0	0	0	0
NR	2	0	0	0	0	0	0
	A	B	C	D	E	F	V
WRITTEN VS. DISTANCE							

A	0	0	0	0	0	0	0
B	0	1	1	0	0	0	0
C	1	1	2	2	0	0	0
D	5	6	15	1	2	1	0
E	1	8	1	1	1	3	0
F	0	2	0	0	2	0	0
NR	2	0	0	0	0	0	0
	A	B	C	D	E	F	V
TELEPHONE VS. DISTANCE							

HI	0	2	0	0	0	1	0
	4	6	7	0	3	1	0
	2	10	10	3	1	1	0
	1	0	2	1	1	1	0
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
LO	2	0	0	0	0	0	0
	A	B	C	D	E	F	V
DIRECT/INDIRECT VS. DISTANCE							

COM	1	6	7	3	0	1	0
USY	6	11	11	1	5	3	0
MOD	1	1	1	0	0	0	0
SEL	0	0	0	0	0	0	0
RLY	0	0	0	0	0	0	0
VAR	0	0	0	0	0	0	0
NR	1	0	0	0	0	0	0
	A	B	C	D	E	F	V
SATISFACTION VS. DISTANCE							

INTERFAC Printout

p.2

## APPENDIX B

### Sample HINDSIGHT Instruments

PROGRAM OF RESEARCH ON THE  
MANAGEMENT OF RESEARCH AND DEVELOPMENT

Department of Industrial Engineering and Management Sciences  
The Technological Institute  
Northwestern University  
Evanston, Illinois

GROUP INTERFACE QUESTIONNAIRE  
for  
Project HINDSIGHT

This document consists of:

Instructions for the Field Researcher - 1 page

Group Interface Questionnaire - 9 pages

## INSTRUCTIONS FOR THE FIELD RESEARCHER

### DESCRIPTION OF INSTRUMENT:

This questionnaire consists of one part, as follows:

#### III.3.2 Group Interface Questionnaire

### GENERAL INSTRUCTIONS:

This questionnaire is designed to be administered to Members of each RXD Event Group and each Selected Group.

This questionnaire is independent of any other research instrument and may be administered at any time without regard to sequence. Because the information to be obtained will be used in preparation for administration of the Group Interaction Questionnaire (III.15), it should be completed as early as possible.

### PREPARATION FOR ADMINISTRATION:

Reference should be made to the "Group Reference Form" (III.1.2) information prepared on each RXD Event Group and each Selected Group.

Enter your ORIGINATOR CODE at the top of each page for identification (e.g., NU(ABC) ). Prepare sufficient reproducible copies for each RXD Event Group and each Selected Group.

For each Group, enter the name of the Group on Page 1. Identify an Event attributed to the Group which required some degree of information exchange with other Groups; you may start by referring to the "Ideas, Projects and Events" inventories (III.2) if it has been completed for the Group. If not, you will have to obtain this information from an informant or a Member of the Group. In both cases, you may have to obtain information on the degree of information exchange and the Time Period from an informant or a Member of the Group. Enter the Name of the Event and the Time Period on Page 1. Reproduce sufficient copies for each Member of the Group.

### GENERAL INSTRUCTIONS ON ADMINISTRATION:

The questionnaire is designed to be self-administered. There is no objection, however, if you wish to administer some or all of the questionnaires by personal interview. It may be desirable to administer by interview at least one of the questionnaires to uncover any questions of interpretation.

At the time of administering (or completion of) the questionnaire, enter the date below your ORIGINATOR CODE.

ORIGINATOR	DATE	PROJECT	INTERVIEWEE	SITE	INSTRUMENT NUMBER III.3.2	PAGE NUMBER 1 of 9
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### GROUP INTERFACE QUESTIONNAIRE

Referenced Group:

Name of Referenced RXD Event:

Interviewee:

RXD Event Time Period:

\_\_\_\_\_ to \_\_\_\_\_

The purpose of this questionnaire is to obtain information about the groups that were interrelated to the work of your group on the Event listed above during the Time Period listed above.

All questions are to be answered with respect to this Event and Time Period.

None of your responses will be attributed to you by name. The names you provide in answering questions 1-5 will be combined with names furnished by other Members of your Group for use in a subsequent questionnaire which will be administered to you and others in your Group. If, for any reason, you do not wish any particular name you list to be included in the combined list, please make a note that the name should not be included. In this case, the name will appear on the list only if furnished by others.

In the first five questions below, please list the names, as well as you can remember, of those persons who meet the particular description. In each case you should include only those whom you consider to be technical personnel.

1. Persons in your Group who were concerned with the Referenced Event who were under the technical and administrative supervision of the supervisor of your Group.


2. Persons in your Group who were concerned with the Referenced Event who were under the administrative supervision of the supervisor of some other Group, i.e., persons who were on "loan" to your Group but reported elsewhere for payroll, promotion, etc.


ORIGINATOR	DATE	PROJECT	INTERVIEWEE	SITE	INSTRUMENT NUMBER	PAGE NUMBER
					III.3.2	2 of 9

3. Persons in some Group other than yours who were closely related to the technical work in your Group, i.e., in terms of technical contribution they were accepted as members of your group.


4. Persons in some Group other than yours who were closely related to the technical work in your Group but were not considered "members" of your Group.


5. Any other persons who appear to almost fit into one or more of the above categories. Please feel free to add any comment or qualification that you wish.


6. Name the group that knew the most about the problem, the idea, or the requirements before work formally started on the Event.

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7. Name the group or source that provided the funds for doing the work.

--

ORIGINATOR	DATE	PROJECT	INTERVIEWEE	SITE	INSTRUMENT NUMBER III.3.2	PAGE NUMBER 3 of 9
------------	------	---------	-------------	------	------------------------------	-----------------------

Read the next three questions and note the distinctions before answering any one. Select the number from the scale below that you feel adequately expresses your response to the questions and write it in the boxes next to all questions.

Not Applicable NA	Essentially None 1	Some 2	Moderate 3	Large 4	Completely 5
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8. To what extent were the technical requirements of the problem from which the Event evolved provided by--

☐ The customer (name): \_\_\_\_\_

☐ An in-house group: \_\_\_\_\_

☐ Your own group

☐ Other (name): \_\_\_\_\_

9. To what extent did the technical characteristics of the solution depend upon fixed data, parameters, specifications, etc., provided by other groups? I.e., the information provided was essentially not subject to change--you were "stuck" with it.

☐ In-house group(s) ☐ The customer

☐ Other (name): \_\_\_\_\_

10. To what extent did the technical characteristics of the solution depend upon data, parameters, specifications, etc., design decisions made by other groups where your group--hypothetically or actually--could have influenced the decision? I.e., what was the extent of the mutual interdependence of your work with theirs?

☐ Group: \_\_\_\_\_

☐ Group: \_\_\_\_\_

☐ Group: \_\_\_\_\_

☐ Group: \_\_\_\_\_

☐ Group: \_\_\_\_\_

ORIGINATOR	DATE	PROJECT	INTERVIEWEE	SITE	INSTRUMENT NUMBER	PAGE NUMBER
					III.3.2	4 of 9

11. With what groups did you occasionally or regularly seek or provide advice, comment, or criticism with regard to the Event?

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12. Disregarding contractual, legal, and formal niceties, what group did you really consider as the "customer" or chief user of your group's work on the Event? (E.g., "Our own group at a later time," is one possible answer.)

---

13. After your group essentially completed work on the Event, what other in-house groups made use of it?

☐ Group: \_\_\_\_\_

☐ Group: \_\_\_\_\_

☐ Group: \_\_\_\_\_

☐ Some other group(s), too.

☐ None, to the best of my knowledge.

In questions #6 through #13 you have identified from one to perhaps a dozen groups. Please transcribe their names onto page 9. Answer the following questions for each of these groups. Please place the indicated code symbols or numbers for each question (column) in the row for each group you have named. You may detach page 9. When you have completed this questionnaire, please re-staple it to page 9.



ORIGINATOR	DATE	PROJECT	INTERVIEWEE	SITE	INSTRUMENT NUMBER	PAGE NUMBER
					III.3.2	5 of 9

14. What was the physical "distance" to the group from your location?  
If moves occurred write in as many codes as necessary.

- A - Same room or only a few steps away.
- B - "Down the hall"; a minute away.
- C - On a different floor; a few minutes away.
- D - In a nearby building; several minutes away.
- E - "Across town"; a fraction of an hour or an hour away.
- F - In another town; more than an hour or so away.

15. With what group(s) did you have--

- M - The most communication
- L - The least communication
- A - Roughly average amount of communication  
relative to M and L.

16-18. How did the amount of communication between your whole group and each of the named groups vary during the period of work on the Event? (Same code as above.)

16. During the initial period (often the first  $\frac{1}{2}$ )?

17. During the mid period (often the middle  $\frac{1}{2}$ )?

18. During the end period (often the last  $\frac{1}{2}$ )?

Please date the periods you had in mind:

Initial: \_\_\_\_\_ to \_\_\_\_\_

Mid: \_\_\_\_\_ to \_\_\_\_\_

End: \_\_\_\_\_ to \_\_\_\_\_

19. To the best of your knowledge, approximately how many people made up each of the groups listed?

20. How many people from your group were in (more or less) regular contact with each group? If significant variations occurred in the initial, mid, and end time periods give three numbers-- e.g., 2/8/1.

21. How many people in each group were the (more or less) regular recipients of these contacts? Indicate significant time variations in the same manner.

ORIGINATOR	DATE	PROJECT	INTERVIEWEE	SITE	INSTRUMENT NUMBER	PAGE NUMBER
					III.3.2	6 of 9

22. With which groups were there formal "liaison arrangements of the following types--

- A - A supervisor, manager, special assistant, etc., from a point in the organization above the supervisors of both groups.
- B - A "liaison agent" not responsible to a supervisor in either group.
- C - A member of one group designated as the "contact man" for the other group.
- D - A member of one group assigned to work at least part time in the other group.
- E - None of the above liaison arrangements.

23-27. Please use the following scale for this group of questions.

- A - Several times a day.
- B - Several times a week.
- C - About once a week.
- D - About once a month.
- E - Less than once a month.
- F - Never.

Approximately how often was there communication between your group and the others listed--

- 23. At formal conferences and meetings?
- 24. Through an intermediary, not a member of either group?
- 25. By personal, face-to-face conversations?
- 26. By written notes, memos, letters, reports, or transfer of documents?
- 27. By telephone?

28. How well satisfied was your group with the information exchanges--not just content, per se--with each other group?

- R - Rarely satisfactory
- S - Seldom satisfactory
- M - Moderately satisfactory
- U - Usually satisfactory
- C - Completely satisfactory
- X - Varied tremendously

ORIGINATOR	DATE	PROJECT	INTERVIEWEE	SITE	INSTRUMENT NUMBER	PAGE NUMBER
					III.3.2	7 of 9

29. Assuming government security regulations were met, how free did you feel to give information concerning your work to a person from another group?

- ☐ I always referred him to my supervisor for information.
- ☐ My supervisor had to indicate it was OK before I gave him information.
- ☐ It depended upon which group he came from.
- ☐ It depended upon how our work was going.
- ☐ I always gave as much information as I could.

30. To what extent does this questionnaire now indicate the true situation?

- ☐ Grossly oversimplified
- ☐ So-so
- ☐ Presents a good picture

ORIGINATOR	DATE	PROJECT	INTERVIEWER	SITE	INSTRUMENT NUMBER	PAGE NUMBER
					III.3.2	8 of 9

31. The questions above have touched upon various aspects of technical interrelationships, organizational factors and have provided a little indication of changes with time. Considering these factors, and others as appropriate, such as reorganizations, changes in urgency, or crises, please describe briefly the most significant aspects of the relations between your group and others.

☐

I wrote more on the back.

☐

I attached additional page(s).



PROGRAM OF RESEARCH ON THE  
MANAGEMENT OF RESEARCH AND DEVELOPMENT

Department of Industrial Engineering and Management Sciences  
The Technological Institute  
Northwestern University  
Evanston, Illinois

GROUP INTERACTION INTERVIEW GUIDE  
for  
Project HINDSIGHT

This document consists of:

Instructions for the Field Researcher - 3 pages

Group Interaction Interview Guide - 1 page

Group and Other-Group Member Activity Worksheet - 1 page

HS FM-III.15

## INSTRUCTIONS FOR THE FIELD RESEARCHER

### DESCRIPTION OF THE INSTRUMENT:

This instrument consists of an interview guide and a worksheet as follows:

- III.15.2 Group Interaction Interview Guide
- III.15.3 Group and Other-Group Member Activity Worksheet

Detailed preparation by the Field Researcher is required prior to administration.

### GENERAL INSTRUCTIONS:

Interviews are to be conducted with Members of each RXD Event and Selected Group, with Members of other Groups as identified from the administration of the Group Interface Questionnaire (III.3), and with the respective individuals identified as First Line Technical Supervisors and as "General Management" with respect to each Group.

The administration of this instrument to the Members of any particular Group (or any other interviewee chosen on the basis of that Group) cannot be accomplished until the data called for by the Group Interface Questionnaire (III.3) is obtained for that Group.

### PREPARATION FOR ADMINISTRATION:

Reference should be made to the "Group Reference Form" (III.1.2) information prepared on each RXD Event Group and each Selected Group.

Reference should be made to the Group Interface Questionnaire (III.3) information prepared on each RXD Event Group and each Selected Group.

In addition to the Group Interaction Interview Guide (III.15.2) and the Group and Other-Group Member Activity Worksheet (III.15.3), you will require a supply of blank paper for making notes. You may wish to use the General Data Forms (I.4.5 and I.4.6).

Enter your ORIGINATOR CODE at the top of the Group and Other-Group Member Activity Worksheet (III.15.3) for identification (e.g., NU(ABC) ). Prepare sufficient reproducible copies for each RXD Event Group and each Selected Group.

For each Group, enter the Name of the Group and the Name of the Referenced Event. Using the Group Interface Questionnaire (III.3) prepared by Members of the Group, list on the Worksheet all of the

names which were provided in answer to questions one through five.  
Note: If an individual interviewee has noted that he does not want a particular name so listed, do not list it unless it appears on a questionnaire prepared by another interviewee. Reproduce enough copies for each person who will be interviewed with respect to the Group.

Prior to administering each Worksheet, enter on each page, after your ORIGINATOR CODE, in the box provided, the Identification Code of the interviewee. This "code" appears next to the name of the interviewee on the "Group Reference Form." (Note: The addition of the name of the interviewee is optional; it may be useful to provide for direct identification during administration.)

#### GENERAL INSTRUCTIONS ON ADMINISTRATION:

This instrument is designed to be administered by personal interview. At the time of administering enter the date in the box provided.

#### SPECIFIC INSTRUCTIONS FOR ADMINISTRATION:

This instrument is in the form of a partially structured interview. There is no particular requirement that the questions be asked in the order they are presented, but it is suggested that the first question be used as the beginning point of the interview.

The answers to question two will be written down on the Group and Other-Group Member Activity Worksheet (III.15.3). All of the other answers will be written in the form of notes. There is no particular requirement as to form, but each page should be identified with your ORIGINATOR CODE, date, interviewee's Identification Code, and the identifying number of the Guide (III.15.2).

Note that answers to question two, or modifications of earlier statements, come obtusely later in the interview--if the questions are presented in the order given here.

Interviewees who were in "General Management" at the time of the Event may not be able to answer question two.

You may find it quite helpful to have put the names of the groups on 3 X 5 cards for the interviewee to use in illustrating his points. It may also be helpful to have another set of cards with the names of the individuals listed on the Worksheet. Parts A and C of question two may then be answered by a Q-sort process adapted to the interview. You are likely to find, whether or not a Q-sort is used, that having the cards to handle will put the respondent at ease and provide more useful information in questions three and four as well.



During an interview, the only completed Group Interface Questionnaire (III.3) which you should have present is the one filled out by that particular interviewee.

Information answering particular questions about administration will be provided in the form of operational instructions.

GROUP INTERACTION  
\*INTERVIEW GUIDE\*

1. Review with the interviewee the relationship among the interfacing groups listed, and the nature of the interactions as indicated, in the Group Interface Questionnaire.
2. A. Which of the people listed on the Group and Other-Group Member Activity Worksheet (III.15.3) carried information back and forth among two or more groups?  
  
B. How effective were they in transferring information--variation with time and other factors?  
  
C. If they belonged to another group were they thought of as, or would they have been wanted as, active members of the interviewee's group?
3. When did periods of crisis occur with respect to:  
  
    --technical work of the interviewee's group?  
  
    --technical work affecting the whole program or organization?  
  
    --management of the program or organization?
4. Elicit a number of incidents that involved the interfacing groups where there was an observable outcome that was:  
  
    --clearly successful (constructive or "good"),  
  
    --clearly unsuccessful (disruptive or "bad").  
  
Include normal or everyday situations as well as crisis situations. Comparing everyday and crisis situations, note in as much detail as possible remarks indicating:  
  
    --changes in amount of communication between groups;  
  
    --changes in ability or freedom to communicate, imposition or relaxation of controls;  
  
    --changes in felt urgency.  
  
The following, in a manner appropriate for the interviewee, may be of help in developing question four above:
5. How well did the formal liaison arrangements work? To what extent were they circumvented?



## APPENDIX C

### Sample Pilot Study Instruments

## INTRODUCTORY INFORMATION

### Organizational Field Study

A group of graduate students at Northwestern University is conducting a study of work preferences, organization structure and communications. The questions they ask you will contribute important information to this study.

No member of your organization will see your answers to any of the study questions, and all the data you give the researchers will be held in confidence. The name of your company will also be confidential, so your responses will in no way identify you.

There are two parts to this study. First, an interviewer will ask for information about your job, the department you work in, and your contacts with members of your company. The second part is a short questionnaire which concerns your work preferences and feelings about other jobs.

Your cooperation in this study is sincerely appreciated.

## INTERVIEW GUIDE

1. In which department within the company are you presently employed?  
\_\_\_\_\_

2. What is your job title?  
\_\_\_\_\_

3. Who is your immediate superior?  
\_\_\_\_\_

4. What is his job title?  
\_\_\_\_\_

5. Explain that these cards are names of people the subject may or may not know within the company. Some are in his department and some are in others. Hand the subject the deck of cards and ask him to:

PLEASE SEPARATE FROM THE DECK THOSE PERSONS WHO ARE MEMBERS OF THE IMMEDIATE GROUP OF PEOPLE WITH WHOM YOU NORMALLY WORK.

If necessary, explain that we want the people he "regularly works closely with,"..."regularly contacts in the normal course of work." Record the code numbers on the code sheet.

- Probe: Were there any names not among the cards that the subject feels should be included? If so, make up a card with the appropriate name on it, supply a code number and record the information.

6. Combine the deck of cards into one stack and again hand them to the subject. Ask him to:

NOW PLEASE SEPARATE FROM THE DECK THOSE PEOPLE WHO YOU RECEIVE DIRECTIONS OR INSTRUCTIONS FROM ABOUT YOUR WORK.

Record the code numbers on the code sheet.

- Probe: Were there any names not among the cards that the subject feels should be included? If so, make up a card with a new code number and record the information.

7. Combine the deck of cards into one stack and again hand them to the subject. Ask him to:

NOW PLEASE SEPARATE FROM THE DECK THOSE PEOPLE WHOM YOU GIVE DIRECTIONS, SUGGESTIONS OR INSTRUCTIONS TO ABOUT THEIR WORK.

Record the code numbers on the code sheet.

- Probe: Were there any names not among the cards that the subject feels should be included? If so, make up a card with a new code number and record this information.

8. What are your duties within the company?

Probe: a. Ask subject to describe briefly.

b. Is this an official duty (delegated specifically to the subject) or an unofficial duty (for some reason such as his past experience or convenience he is doing the job without official sanctions)?

(c.) Is this duty critical, very important, of moderate importance, or not very important?

9. What are the functions of your department?

Probe: a. Ask subject to describe briefly.

b. Is this an official function (delegated specifically to the department) or an unofficial duty (one that for some reason the department is doing without official sanction)?

(c.) Is this function critical, very important, of moderate importance, or not very important?



10. What typical problems or conflicts arise in your department?

Probe: a. Are these within or between departments?

b. How typical are these conflicts or problems.

c. Ask the subject to give an example of problems or conflicts he mentions.

d. Ask the subject why he thinks these problems or conflicts arose.

e. Ask the subject what he thinks the effects of each problem or conflict are on the company as a whole.

11. **TRANSITION STATEMENT:** The following questions are designed to help us to measure the communication patterns within your company. The first few will involve a sorting procedure similar to the one used at the beginning of the interview. If you feel there are any persons omitted from this deck who are necessary for us to get an accurate picture of the communication in your company, tell us and we will make up additional cards. As a first step:

PLEASE CHOOSE FROM AMONG THIS DECK OF CARDS THOSE PERSONS WHOM YOU HAVE CONTACT WITH OR COMMUNICATE WITH ON YOUR JOB.

If necessary, explain that by contact or communicate, we mean "all contact beyond mere pleasantries and friendly greetings." Record the code numbers in the appropriate line on the REPORT SHEET.

12. Explain to the subject that he will use the cards he has selected in question 11 for the next several questions. Ask the subject to:

PLEASE ARRANGE THE CARDS INTO THREE PILES ACCORDING TO ORGANIZATIONAL POSITION.

Put key cards on the table to indicate the categories:

- (a) work group, immediate group with which you work
- (b) own department but not work group
- (c) other department

Record this information in the column on the REPORT SHEET by writing the code number after the appropriate letter showing the categories for the question.

13. Ask the subject to:

PLEASE ARRANGE THE CARDS INTO FOUR PILES ACCORDING TO THE REASON FOR COMMUNICATION OR CONTACT.

Put key cards on the table to indicate the categories:

- (a) Technical knowledge
- (b) Ability to communicate with others and find needed information
- (c) Social reasons
- (d) Position in the flow of work (normal, on the job contact)

Record this information in the column on the REPORT SHEET by writing the code number after the appropriate letter.

[If necessary, distinguish between (a) and (d) on the basis of willingness: technical knowledge implies a desire to communicate because the other person possesses some desired knowledge; flow of work implies that one is forced to communicate because of the particular constraints of the job..secretary, etc.]

14. Ask the subject to:

PLEASE ARRANGE THE CARDS INTO THREE PILES ACCORDING TO THE TYPE OF COMMUNICATION OR CONTACT HE HAS WITH THESE PEOPLE.

Put key cards on the table to indicate the categories:

- (a) Administrative, pertains to salary, promotion, vacation, etc.
- (b) Technical; job-related information such as specifications, etc.
- (c) Social; matters not directly related to your job such as family, sports, etc.

Record this information in the column on the REPORT SHEET by writing the code number after the appropriate letter.

15. Ask the subject to:

PLEASE ARRANGE THE CARDS INTO FIVE PILES ACCORDING TO THE FREQUENCY OF COMMUNICATION OR CONTACT HE HAS WITH THESE PEOPLE.

Put key cards on the table to indicate the categories:

- (a) Several times a day
- (b) Once or twice a day
- (c) Two or three times a week
- (d) Two or three times a month
- (e) Less than two or three times a month

16. Ask the subject to:

PLEASE ARRANGE THE CARDS INTO THREE PILES ACCORDING TO THE METHOD OF COMMUNICATION OR CONTACT.

Put key cards on the table to indicate the categories:

- (a) Mostly face-to-face or telephone; (very little memo, letter, etc.)
- (b) About half face-to-face and telephone; (half memo, letter, other)
- (c) Very little face-to-face, telephone; (mostly letter, memo, etc.)

Record this information in the column on the REPORT SHEET by writing the code number after the appropriate letter.

17. Ask the subject to:

PLEASE ARRANGE THE CARDS INTO FIVE PILES ACCORDING TO THE tone  
OF THE COMMUNICATION OR CONTACT.

Put key cards on the table to indicate the categories:

- (a) Always friendly
- (b) Generally friendly
- (c) Friendly, but occasional disagreements...settled easily
- (d) Argumentative, difficult to reach agreement
- (e) Mostly unfriendly

Record this information in the column on the REPORT SHEET by  
writing the code number after the appropriate letter.

18. In your opinion, which of the people on the cards you have been  
sorting are most valuable to you as contacts and communicators  
of job-related or technical information? (If he asks how many,  
give a general answer, but no more than six people).

Probe: How effective would you say these people are?  
Extremely effective, moderately effective, little effect...

How or why are these people valuable to you? (Get person by  
person comments if possible).

NAME OR CODE #	EFFECTIVENESS	OTHER COMMENTS
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19. From sources outside your department where do you receive useful technical or job-related information? For example, do you have "contacts" in other departments which are helpful to you in getting information necessary for your job?

Probe: Do you consider these sources to be part of your work group, regardless of organizational boundaries? For instance, do these sources regularly work closely with you?

The following question is to be administered to the people in the Research and Development segment of the company.

20a. In talking with field salesmen, do you find that they understand your technical information?

Probe: a. Have the subject briefly explain his answer.

b. Do salesmen understand when you must hedge a technical answer? [Hedge: must qualify or give an uncertain answer; not pinned down].

The following question is to be administered to the people in the Sales department segment of the company.

20b. Do research and development people appreciate the need for prompt action on your requests?

Probe: a. Have the subject briefly explain his answer.

b. How would you rate the reports you receive from Research and Development on the basis of clarity and brevity? Do they aid your understanding of the questions you ask?

c. Could research and development reports be improved? If so, how?

21. Realizing that one's work does not always stop at lunch hour, quitting time, etc., can you think of instances in which you discuss your work when not actually on the job?

- Probe:
- a. Are these discussions more typically with persons from one or two specific departments rather than others?
  - b. How frequently would you say these discussions occur?
  - c. Why would say these discussions occur?



# REPORT SHEET

11. Contacts

12. Organizational Position

A.

B.

C.

13. Reason

A.

B.

C.

D.

14. Type

A.

B.

C.

15. Frequency

A.

B.

C.

D.

E.

16. Method

A.

B.

C.

17. Tone

A.

B.

C.

D.

E.

Remarks:

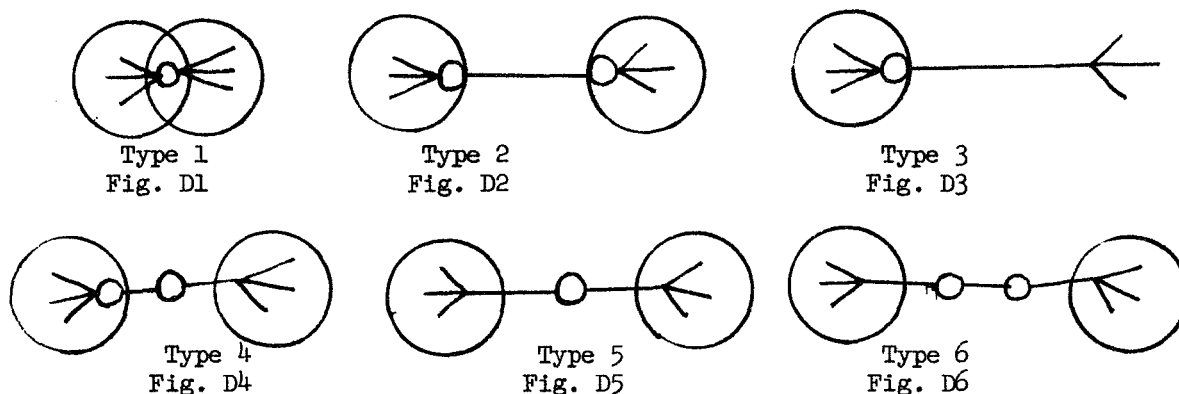
## APPENDIX D

Procedure for identifying liaison agents

Sample Work Sheet

Procedure for identifying potential liaison agents:

This procedure assumes that work groups have already been identified. Reference is made to various "types" of liaison as shown below in Figures D1-D6. The figures are arranged in order of the number of information exchanges which must occur across or outside of group boundaries for a message to be transmitted from all the members of one group to all the members of another group of equal size. (i.e., There are zero such exchanges for D1 regardless of the number of group members. If each group has three members, there are four exchanges in Fig. D4; seven in Fig. D6.)



In the following discussion, "most" means "more than one-half."

STEP 1.--For each group, enter in List I all those persons who are contacted by most of their own group. Enter in List II all those persons outside the group that most of the group contact.

STEP 2.--If any persons appear in List I in two or more groups, a potential Type 1 liaison exists. If any persons appear in List I in one group and List II in another group, a potential Type 3 liaison exists. If any persons appear in List II in two or more different groups, a potential Type 5 liaison exists.

	List I	List II
	names	names
Group A	.	.
	.	.
	.	.
	.	.
Group B	.	.
	.	.
	.	.
	.	.
Group C	.	.
	.	.
	.	.
	.	.

Fig. D7

STEP 3.--If any person remain in List I and they have been interviewed, list all the persons they contact. If any of the persons on this list are in another group in:

- a) List I, a potential Type 2 liaison exists.
- b) List II, a potential Type 4 liaison exists.

STEP 4.--If any persons remain in List II and they have been interviewed, list all the persons they contact. If any of these are in another group in:

- a) List I, a potential Type 3 liaison exists.
- b) List II, a potential Type 6 liaison exists.

STEP 5.--If any persons remain in List I and they have not been interviewed, and persons remain in other groups in:

- a) List I and List II, potential Types 2, 3, and 4 may exist.
- b) List I only, potential Type 2 liaison may exist.
- c) List II only, potential Types 3 and 4 liaison may exist.

STEP 6.--If any persons remain in List II and they have not been interviewed, and other persons remain in other groups in:

- a) List I and List II, potential Types 3, 4, and 6 may exist.
- b) List I only, potential Types 3 and 4 may exist.
- c) List II only, potential Type 6 may exist.

Person Contacted											
Respondent	1	2	3	4	5	6	7	8	9	.....	
1	X	†		⓪	✓	⓪ <sup>+</sup>		✓	†*		
2	†	X				✓					
3	✓		X		⓪	†					
4		†		X		†	✓	⓪		✓	
5	✓	✓	✓		X	⓪	✓		†**		
6	⓪		✓	⓪	⓪	X		†✓			
7	✓		†*				X		†	✓	
8		†		†	†	⓪ <sup>+</sup>		X			
9	†	✓		⓪	†	†✓	✓		X		
.											
.											
.											

✓ - indicates that person is considered part of the respondent's work group.

⊙ - indicates that person is contacted at least once or twice a day by the respondent

\* - indicates that person is rated low on the tone of communication

+ - indicates that person is considered an effective communicator

† - indicates that person is contacted at least occasionally

Sample Work Sheet

Fig. D-8

## APPENDIX E

List of suggestions contained in the thesis

### Suggestions Collected from the Thesis:

The following list is a collection of various suggestions made throughout the thesis with regard to future research topics and various considerations to be recalled in future work. They are listed in the order they appear in the thesis and are identified in terms of the section in which they appear.

Section	Suggestion
II.3.1	Research may be undertaken to clarify whether certain qualities are valuable for the different liaison functions of boundary definition, integration, and translation.
III.1.3	Research and conceptual development may be undertaken to more clearly understand and evaluate the effects of retrospective data collection. Verification may be made of the "halo" effect and the "assisting-the-memory" effect.
III.1.5.1	It is necessary to do further work to evaluate the effect of distance on the ratio of interactive to noninteractive communication. The data available are not clear on this relationship.
III.1.5.1	Research on the possibility of "differential remembering" may clarify the finding that distance was found to be inversely related to the number of persons contacted in other groups, but not related to the number of persons in one's own group who were contacting. This may also contribute to a better understanding of retrospective data.
III.1.5.2	It is necessary to devise better methods of establishing work group membership than were used in the HINDSIGHT study. Also, it should not be assumed that members of the organizationally defined group are automatically accepted as work group members.
III.1.5.2	Further research may attempt to determine the causality of the apparent relationship between being perceived as an effective liaison agent and being perceived as a work group member.
III.1.5.3	From the HINDSIGHT data available, it was not possible to determine whether no formal liaison arrangements existed or whether such arrangements existed but were perceived as informal by the group members. Future work might investigate perceptions related to liaison arrangements.
III.1.5.3	Only preliminary data were available on the pattern of the amount of communication during a project. If project stage is an important factor in the study of liaison activities, future work may investigate more thoroughly the communication pattern over a project's life.
III.1.5.4	The data on satisfaction with communication were bunched together. Further research may investigate whether this bunching is a result of normally satisfying communication, retrospective data collection, or the possibility that communication satisfaction is heavily influenced by the degree to which the technical purpose of the project is accomplished.

Section

Suggestion

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- III.1.5.4 The data were not clear on whether communication amount may be related to liaison existence, and if so, in what direction it would be related.
- III.2.4.2 It is not intuitively clear what the relationship would be between frequency of communication and liaison agents as opposed to frequency of communication and other persons.
- III.2.5 Research may be undertaken to determine whether there is any significant difference between the characteristics of liaison at research department interfaces and other interfaces.
- III.2.6.1 Subsequent work may include consideration of the variables of perceived management attitude and organizational structure. It is also necessary to devise better methods of ascertaining the existence of liaison agents and of determining work group membership.
- IV.1.3 It is suggested that all future instruments allow some space or time for the respondent to reply in an unstructured manner as typified by "free-for-all" questions.
- IV.1.4 It seems desirable to include some means of assessing "project crisis" in future attempts to investigate crisis phenomena.
- IV.2.5.2 It is felt that sampling procedures may be quite feasible to use in further studies of liaison activities where routine occurrences are as important as non-routine happenings.
- IV.2.5.2 It is necessary to utilize self-reporting techniques in a cautious manner so as not to contaminate what is being studied.
- IV.2.7 This section summarizes several suggestions regarding the methodology of future studies of liaison and interface activities.